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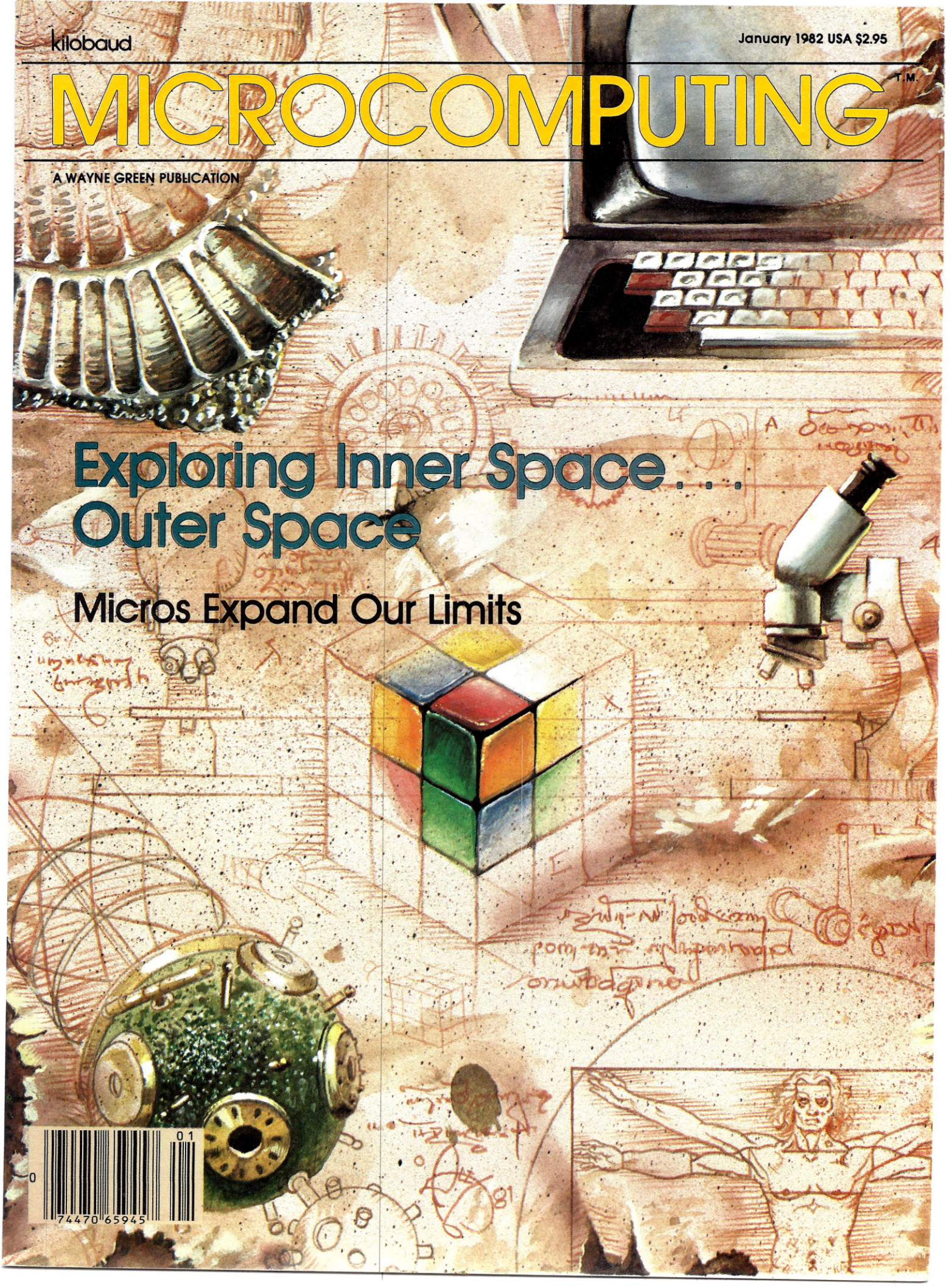

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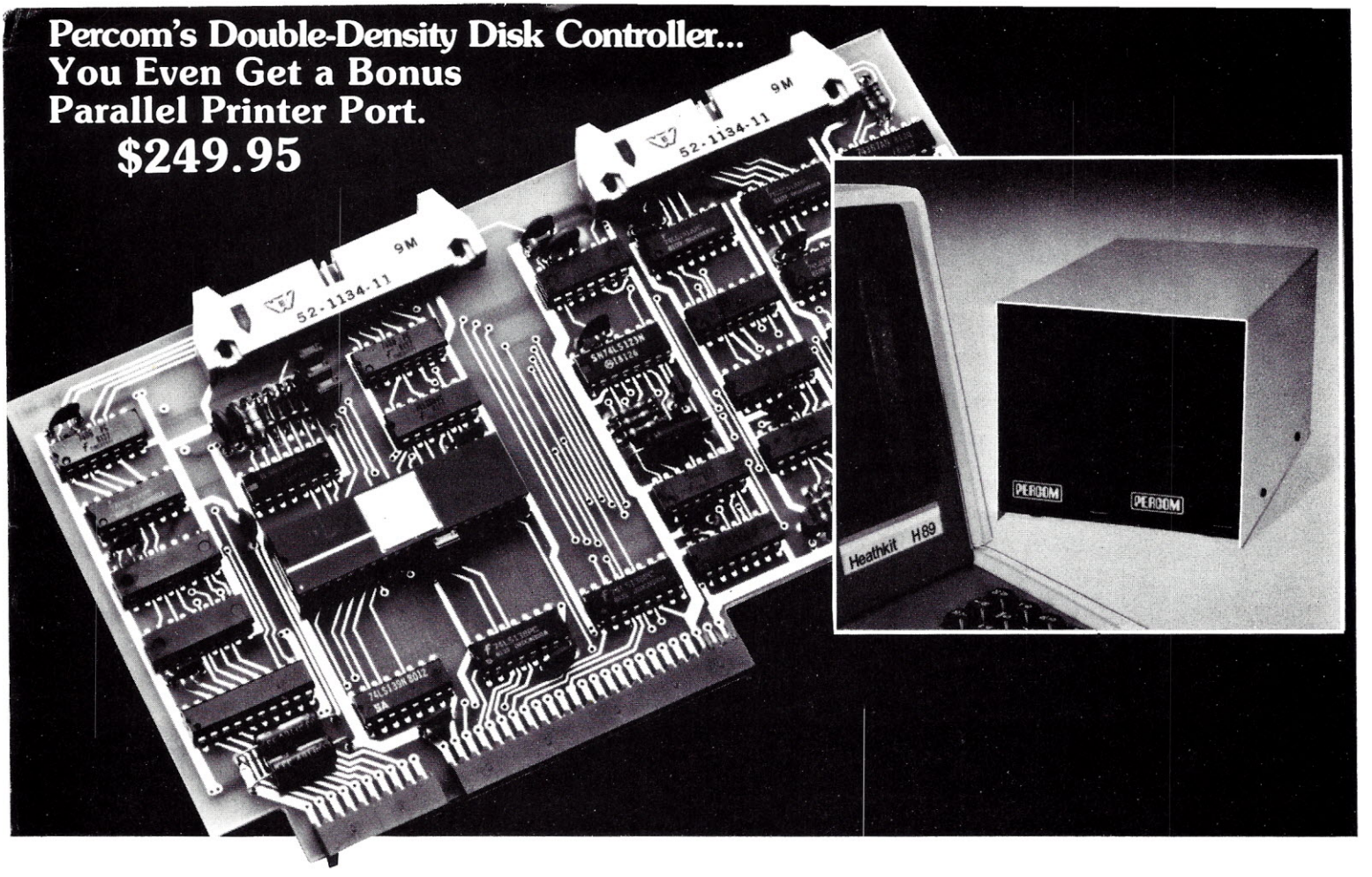

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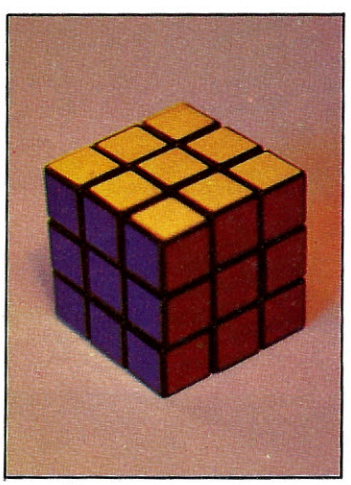

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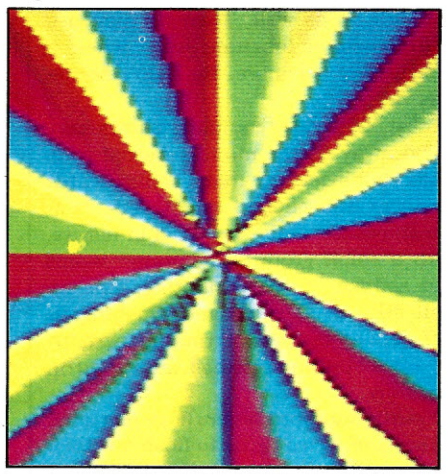

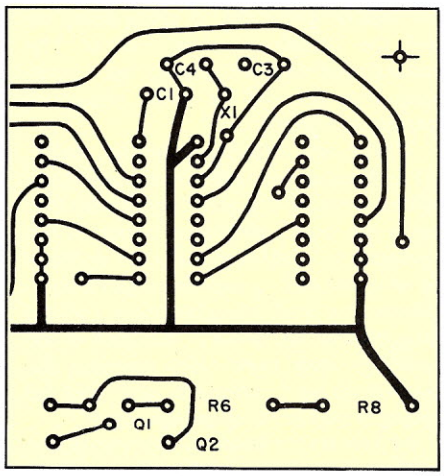

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By Wayne Green

Computer Games Wear Thin

When Will The Industry Grow Up?

The Arcade Misunderstanding

Arcade games are a lot of fun. Even the early pong games were a ball. I remember spending hours slipping quarters into an Atari tank war game in Atlantic City during the first computer show there. But somehow the fun of the pong games didn't seem to carry over into playing them on my home television. Something got lost in the translation. The novelty and excitement of even the advanced color pong, with a half dozen different (but similar) games, only lasted a week or so.

Early computer hobbyists, remembering the fun of arcade games and having played Star Trek on a big computer, spent hundreds of dollars and hundreds of hours building a computer so they could play . . . only to become bored within a few days. Other hobbyists spent their time and money building a system to play the Game of Life, a real thriller—for an hour or two.

Apparently not aware of this syndrome, several firms have spent millions of dollars to bring computerized games to the public. The Mattel ads on television attempt to illustrate how much more wonderful their stick men playing baseball are than the Atari stick men. After the debacle with pong and super pong, I wonder how many people are going to shell out from a few hundred to a thousand dollars to play games. Is it really worth several hundred dollars to play computer hangman?

Games are still selling well for most systems, though even the best of the adventure games seem to wear thin after a few hours. Simulations seem to hold one's interest better than plain games, so I suspect that these will be improved and eventually replace most of today's games.

I don't have the fun playing against the computer (as in Star Trek) that I do against people. I enjoy winning against people and get no particular thrill out of winning or losing to a computer. It isn't the same . . . any more than playing the tank game on my Atari at home is as much fun as shooting 'em up in an arcade—even at a quarter for a few minutes.

I'm much more interested and enthusiastic about computer applications. I enjoy seeing the sales curves of the various publications we put out, and like to keep track of the couple hundred projects which are moving along. I enjoy using the computer where it is doing work for me, but it gets switched off when it comes to games. Besides, how do I know that it *really* is choosing random numbers when it plays against me? Damned thing probably cheats. I don't trust 'em.

I get the same feeling in Vegas when I come up against a computerized one-armed bandit. With the old mechanical ones you could sort of forget that they, too, were programmed to screw you. With the computer bandits I don't ever forget that the screwing is inevitable.

The rage for those handheld computerized games is dying down. We'll get a better idea of where that is going when we see the Christmas sales reports. The manufacturers were griping last Christmas that the fad for these miniature games was fading.

Where will this leave Mattel, Bally, APF, Atari and the other computer firms which went for the game approach? Perhaps my own experience is not in the mainstream and there really *are* millions to be made selling expensive game computers as a continuing business. I would suggest that the firms in this part of the industry keep their sales research departments up to strength, watching for changes and keeping options open.

If *I* were on the board of directors of one of these firms I'd be pushing for business and educational applications just in case the system turned out not to be able to replace cards as an adult game. Me? I'll take a good game of Cribbage or Pitch anytime.

Show Births and Deaths

Was it only five years ago that we saw the first microcomputer show in the country? It seems like ages. It was in Atlantic City, then, as now, a tacky, rundown place to go. But everyone went, with chartered flights for hobbyists coming in from San Francisco. That was in August 1976 . . . and it was there, incidentally, where *Microcomputing* was first announced. We had a booth at the show and sold over a thousand subscriptions.

Most of the firms which exhibited there are now long gone. They were, for the most part, run by hobbyists and succumbed to either too much or too little success. Apple, which had a table right across from our subscription booth, is still around. It was the first public showing of the Apple I, and Steve Jobs picked up about 20 orders from dealers . . . and was on his way.

The chap who put on the show tried it again the next year at Atlantic City, but it didn't do as well. Then he moved it to Philadelphia for three years, where it ran down even more. He didn't bother this year.

Most of the early computer shows have faded away as the interest moved from eager hobbyists to more sophisticated business and educational buyers. Now the shows are almost all local in nature, with a small group of computer stores and software firms exhibiting. The recent ones in Chicago and Washington were about typical . . . running perhaps 50–60 booths and pulling a fair crowd on Saturday.

Frantic show promoters have recruited all sorts of weird firms to flesh out their shows. We see condominium sales from Florida, encyclopedia sales, eyeglass

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cleaner chemicals, telephones, intercoms, office copiers, car gadgets, and so on . . . with the computer stores intermixed. We also see fewer and fewer of the larger firms bothering to exhibit at these shows. They've found that other forms of promotion are far more efficient in selling the product. Indeed, unless you have an extraordinary amount of profit in your product—and it is relatively low in price—shows can lose for you. Local dealers are often able to pick up customers, so they find shows pay off.

To you, the show goer, this means that you are not likely to see much more than you would visiting your local dealer, yet you'll be out around $5 for the entry fee. Of course, if you are anxious to buy an encyclopedia at retail price, you're all set. I've found very few real bargains at shows in the last year or so. With booths costing around $600 to $1000 each, plus the cost of the exhibit and the people to man the booth, you can understand why bargains are not likely. They have to sell a bundle of stuff just to break even.

The word seems to have gotten around that shows can make the promoter rich, hence the proliferation of shows. A recent one in New York, run by a new show entrepreneur, was a disaster. Just about every major city has a show scheduled for this fall and next spring. It will be interesting to see if this settles in . . . or dies out.

Clive Alive!

One of the more interesting cultural micro events in recent times was the visit of Clive Sinclair to Boston, where he did a show and tell of his ZX-81 system.

At $100 for the kit and $150 for the assembled model, people have been buying the ZX-81 just for the hell of it. After all, outside of a lunch in New York, ten lunches in Peterborough or a hundred

One of the more interesting cultural micro events in recent times was the visit of Clive Sinclair to Boston.

lunches at home, what can you get for $100 any more? So people have been buying these computers . . . mostly for fun. Some say they're for their kids.

This new micro-micro is selling like fish and chips in England. Clive said that he'd sold 30,000 of them there in August and 40,000 in September. They're being made by the Timex people for him, so he doesn't even have to cope with a factory and strikes.

The finished model has accounted for 85 percent of their sales in the U.K., so not many buyers are getting the experience of putting the kit together. Presumably they want to use it for something rather than learn about its construction.

Schools have been big purchasers, with over 2900 schools in the U.K. buying them so far . . . that's over half of the secondary schools in the country. Well, it *is* an economical way for a school to advertise that it has a microcomputer for the kids so they will become computer literate.

Clive showed a prototype of a printer which is in the works. It will type at about 50 characters per second, he says, and cost under $100. It will print out the complete screen for you or list your data.

In the U.S. they are selling by mail only. The ads have already hit—two-page-spread color ads almost everywhere! They're looking to sell about 20,000 a month in the U.S. I don't think they will have any problem with that goal.

Microcomputing is interested in articles and programs on the ZX-81 . . . Let's get busy with this one.

Women and the Future

As the invasion of offices by microcomputers continues to expand, what have been considered women's jobs in the past will be hardest hit. Computerized data input will eliminate the need for rows of women doing data input typing. As word processors and electronic mail grow, the typing pool will dry up and even the secretary's responsibilities will diminish, leaving the women in that role either out of work or else needing retraining for some other position.

Will women cope with this by entering business in much the same way that men do, either by starting with a relatively menial job and working upward, or by getting a business education and starting in the middle? Perhaps we will be seeing more women in sales, marketing, advertising, PR, collections and other jobs which will be of increasing importance as computers take over the boring, repetitive work.

Just because people will not have to spend their lives doing boring work is no reason for them to drop out of work entirely.

Investing

Why should the banks be the only ones to get the gravy? Every now and then an investment opportunity comes up where someone could make the same interest as the banks are getting. It seems like a shame to have the banks making all the money. If you've got some extra money which you'd prefer to have working for you, drop a note to me and I'll pass it along to where it might do some good. □

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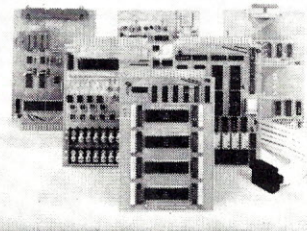

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By Robert W. Baker

Good News For Old PETs

Execom's 80-Column Adapter

80-Column Adapter

Execom Corp. of Racine, WI, has announced an 80-column adapter upgrade for older 40-column PET/CBM systems. It can only be added on 2000, 3000 or 4000 series models that do not have the CRT display controller chip used in the newer systems. The upgrade consists of one two-inch-square logic board for both the 40- and 80-column screen editor ROMs, a 4×5 inch logic board that replaces the original screen RAMs and a separate 80-column reference ROM that can be located in any of the normal expansion sockets.

The circuit board and the ROM combination allows you to switch between the original 40-column display and a new 80-column display. The display selection can be made from the keyboard or through program control with two simple POKE commands. All utility software, like Toolkit, DOS Support (Wedge), Extra-Mon, etc., is compatible in both modes of operation.

Price of the modification is $275 plus installation. The actual installation involves cutting circuit traces on the main PET/CBM logic board, soldering additional wires to the circuit board and installing four new sockets. The installation should only be done by your local dealer or a qualified technician.

Execom Corp. will be offering the installation for $75 (plus shipping), but you must remove your main logic board and return it to Execom Corp. Factory modifications must be prearranged before you can ship the board to them. Also, be aware that this installation may void Commodore's 90-day warranties on new systems. All Execom boards will have a one-year warranty.

Unfortunately, I haven't had the opportunity to see this installed in a system as yet, so I can only pass on what information I have. For more information, see your local dealer or write Execom Corp., 1901 Polaris Ave., Racine, WI 53404.

Formatted Disk Files From Word Pro

I recently came across a Word Pro 3 feature that is hinted at in the manual but not fully explained. For those of you who are currently using Word Pro 3, there is a way to save the formatted output on disk in a sequential data file. There is another option to the output (Control-0) command that is not documented anywhere in the manual. The only options covered are the C for continuous output, G for global and X for multiple copies. The manual does explain how the formatted output will be written on the disk, but not how to generate the disk file.

All you have to do is enter a D option to the normal output command. Word Pro 3 will ask for a drive number and file name, and then write the formatted output to the specified file on disk. The file created will be a sequential data file that you can then use for input to other programs or utilities. Each formatted line is stored on disk as a single data record with a leading quote character. The normal carriage return is used to terminate the line. If multiple blank lines are generated using the LN or FP commands within Word Pro, then multiple carriage return characters will appear at the end of the last printed line.

I've included a program that will read and print the formatted data files created by Word Pro (see Listing 1). This program will handle all page formatting and line spacing correctly but it does not support expanded printing. Any expanded print output will be printed in reverse

```
100 REM ********************************
110 REM
120 REM UTILITY PROGRAM FOR PRINTING
130 REM FORMATTED OUTPUT DISK FILES
140 REM    CREATED BY WORD PRO 3.
150 REM
160 REM          BY: ROBERT BAKER
170 REM   15 WINDSOR DRIVE, ATCO, NJ
180 REM
190 REM ********************************
200 :
210 INPUT "□FILENAME"; F$
220 F$=LEFT$(F$,16): S$=""
230 IF LEFT$(F$,2) <> "0:" AND LEFT$(F$,2) <> "1:" THEN F$="0:"+F$
240 OPEN 15,8,15
250 OPEN 8,8,8,F$+",S,R"
260 INPUT#15,EN
270 PRINT: IF EN=0 THEN 300
280 IF EN=62 THEN PRINT"■FILE NOT FOUND": GOTO 370
290 PRINT"■ERROR:■ ";EN: GOTO 370
300 PRINT"OK, READING FILE..."
310 OPEN 7,4,7: PRINT#7: CLOSE 7 : REM PUT PRINTER IN UPPER/LOWER CASE MODE
320 OPEN 4,4
330 GET#8,C$: SS=ST
340 IF ASC(C$)=13 THEN PRINT#4,MID$(S$,2): S$="": GOTO 360
350 S$=S$+C$
360 IF SS=0 THEN 330
370 CLOSE 4: CLOSE 8: CLOSE 15
READY.
```

Listing 1. Utility program for printing formatted output disk files created by Word Pro 3.

Address correspondence to Robert W. Baker, 15 Windsor Dr., Atco, NJ 08004.

(normal size) on a Commodore printer. This may or may not cause problems.

When you run the program it simply asks for the filename of the file to be printed. A default drive number of zero is automatically assigned. You can indicate a specific drive number by preceding the filename by the drive number and a separating colon. You must, however, enclose the entire string within quotes when specifying the drive number. The program checks that the file exists and then proceeds to start printing each line from the data file. There is a short delay between printing each line, because a GET# command is used to read and check each character of the line. This allows checking for the multiple carriage returns that may exist at the end of any line.

If you think about the possibilities, this Word Pro feature is really valuable. You could create a software package with complete documentation, all formatted by Word Pro, but the user wouldn't need Word Pro to print his own manuals from disk. Actually, this is better than getting printed manuals since you can print as many copies as you want, as often as you want and you don't have to worry about losing your only copy.

Once you've gotten the formatted documentation onto disk as a sequential data file, you can easily copy it onto cassette tape. I've included a copy of my utility program for copying data files from disk to tape (see Listing 2). If you remember back in the Feb. 1981 column, I presented a program for copying tape data files onto disk. Well, this is the other program I mentioned in that column for copying data files back onto disk. It will work for any data file, not just the Word Pro formatted output files.

Once you've gotten the formatted output files on tape, you have to make a few changes to the first printing utility to read the data from tape instead of disk. I've included a copy of the print utility for printing from tape files (see Listing 3). Now you can get first-class formatted documentation without a disk or Word Pro, as long as you have a printer. Actually, you could modify the printing program to just display the information and you wouldn't even need a printer.

If you are writing a program that interfaces with Word Pro files, it may be easier to read these formatted output files instead of Word Pro source (input) files. Word Pro's source files use a special character encoding and have numerous commands within the text. Also, the source files are actually program files instead of sequential data files. The formatted output files have all the format commands removed and only contain the actual data. Everything is in the correct format and the data is now true ASCII coding. This should make the formatted output files easier to deal with.

This Word Pro output option opens a number of applications that many people may not have been aware of before. It might be interesting to see what we can do with it.

Now you can get first-class formatted documentation without a disk or Word Pro.

Jump Vectors

I thought it might be useful to list the jump vectors located at the top of memory in the VIC-20. The corresponding operating-system subroutines can be called by user-written machine-language programs or even from BASIC. I've included a brief description of the operation of each routine and the registers used. Many of these routines are the same as those used in PET/CBM machines, but the addresses may be slightly different. As such, this information should be of general interest. Note that addresses are shown in hexadecimal.

$FF8A—*Restore Old I/O Vectors.* Restores default vector values for system subroutines and interrupts.

$FF8D—*Read/Set Vectored I/O.* If carry is set, the current contents of the RAM vectors are placed in a list pointed at by the X and Y registers. If carry is clear, the user list pointed at by the X and Y registers is transferred to the system RAM vectors.

$FF90—*Control Operating System Messages.* Bits 6 and 7 of the accumulator enable the printing of control and error messages, respectively. If the bit is set then the messages will appear.

$FF93—*Transmit Secondary Command.* Transmits the value in the accumulator as a secondary IEEE address. This routine can only be called after commanding an IEEE to listen.

$FF96—*Send Secondary After Talk.* Transmits the value in the accumulator as a secondary IEEE address. This routine can only be called after commanding an IEEE device to TALK.

$FF99—*Read/Set Top of Memory.* If carry is set, the top of RAM memory pointer is returned in the X and Y registers. If carry is clear, the contents of the X and Y registers are transferred to the top of memory pointer.

$FF9C—*Read/Set Bottom of Memory.* Same as the previous command except for the bottom of memory pointer.

$FF9F—*Scan Keyboard.* Same routine as called by the interrupt handler to scan

```
 100 REM ********************************
 110 REM
 120 REM  DISK-TO-TAPE DATA FILE COPY
 130 REM
 140 REM       BY: ROBERT BAKER
 150 REM 15 WINDSOR DRIVE, ATCO, NJ
 160 REM
 170 REM ********************************
 180 :
 190 PRINT"□INSERT BLANK TAPE IN TAPE#1"
 200 PRINT"& DEPRESS ANY KEY WHEN READY"
 210 GET R$: IF R$="" THEN 210
 220 PRINT"OK": PRINT
 230 OPEN 15,8,15
 240 INPUT"DISK FILE NAME";FL$
 250 PRINT"DRIVE# 0 OR 1: ";
 260 GET D$: IF D$ <> "0" AND D$ <> "1" THEN 260
 270 PRINT D$
 280 OPEN 2,8,2,D$+":"+FL$+",S,R"
 290 INPUT#15,EN,EM$: IF EN<>0 THEN 360
 300 PRINT"OK": OPEN 1,1,1,FL$
 310 PRINT: PRINT"COPYING DATA....."
 320 GET#2,C$: S=ST
 330 INPUT#15,EN,EM$: IF EN<>0 THEN 360
 340 PRINT#1,C$;: IF S=0 THEN 320
 350 PRINT: PRINT"DONE COPY": GOTO370
 360 PRINT: PRINT"□DISK ERROR": PRINT EN,EM$
 370 CLOSE 1:CLOSE 2:CLOSE 15
READY.
```

Listing 2. Disk-to-tape data file copy.

the keyboard. If a key is down, its ASCII value is placed in the keyboard queue.

$FFA2—*Set Timeout on IEEE.* A 0 in bit 7 of the accumulator enables timeouts, while a 1 disables timeouts on the IEEE bus. Timeouts are normally used to avoid hanging in a handshake sequence between devices on the bus.

$FFA5—*Input Byte from IEEE Bus.* Handshakes a byte from the IEEE bus and returns the data in the accumulator. It is assumed that the device has been told to TALK.

$FFA8—*Output Byte to IEEE Bus.* One byte of data is taken from the accumulator to handshake as data on the IEEE bus. A device must be listening or status will reflect a timeout. One character is always buffered by this routine. When the Unlisten subroutine is called, the buffered character is sent followed by the UNLISTEN command.

$FFAB—*Command IEEE Bus to Untalk.*

$FFAE—*Command IEEE Bus to Unlisten.*

$FFB1—*Command IEEE Device to Listen.* The device number from the accumulator is ORed with bits to convert this device number to a listen address and then transmits the data as a command on the IEEE bus.

$FFB4—*Command IEEE Device to Talk.* The device number from the accumulator is ORed with bits to convert this device number to a talk address, and it then transmits the data as a command on the IEEE bus.

$FFB7—*Read I/O Status Word.* Returns the current I/O status in the accumulator. Values are the same as listed for ST in the Commodore manuals.

$FFBA—*Set Logical, First, Second Address.* The accumulator contains the logical file number used by the system to access data stored in a table by the open file subroutine. The X register contains the device number, while the Y register contains the command. The command is sent as a secondary address on the IEEE bus following the device number during an attention sequence. If no secondary address is to be sent, set Y to $FF.

$FFBD—*Set File Name Information.* Load the accumulator with the length of the file name, 0 if opening a file without a file name. The X and Y registers then contain the address of the actual character string corresponding to the file name.

$FFC0—*Open Logical File.* Previous two subroutines must be called first ($FFBA & $FFBD).

$FFC3—*Close Logical File.* Accumulator contains the logical file number of the file to be closed.

$FFC6—*Open Channel for Input.* Opens a channel for input after being opened by the Open subroutine. This subroutine must be executed before attempting to read data from any device except the keyboard. This call may be omitted for keyboard input with no logical file number association.

$FFC9—*Open Channel for Output.* Opens a channel for output after being opened by the Open subroutine. This subroutine must be executed before attempting to write data to any device except the display. This call may be omitted for output to the display with no logical file number association.

$FFCC—*Close Input and Output Channel.* Closes all open channels and restores the default channels, input device 0 and output device 3.

$FFCF—*Input Character from Channel.* Returns a character of data from the open or default channel. The data is returned in the accumulator and the channel remains open after the call. For keyboard input, the cursor is turned on and continues to blink until carriage return is typed. Characters on the line are returned one by one by calls to this routine.

$FFD2—*Output Character to Channel.* Sends a character of data to the open or default channel. The data is taken from the accumulator and may be transmitted to multiple devices on the IEEE bus.

$FFD5—*Load RAM from Device.* Performs a load from a device if the accumulator is 0, a verify if a 1. The X and Y registers contain the starting address for the load if a secondary address of 3 is used. Otherwise, the block will load into memory starting at where the header has specified. On return the X and Y registers indicate the highest RAM address loaded.

$FFD8—*Save RAM to Device.* Saves memory to a logical device from the bottom of memory pointer to the address pointed to by the X and Y registers.

$FFDB—*Set Real-Time Clock.* The accumulator and the X and Y registers are loaded into the three-byte system clock.

$FFDE—*Read Real-Time Clock.* Returns the current three-byte system clock value in the accumulator and the X and Y registers.

$FFE1—*Check Stop Key.* Sets the Z flag if the stop key is pressed while the routine is called, and all other flags are maintained. If the stop key is not pressed, the accumulator will indicate the last row of the keyboard scan. This can be used to check for other key closures.

$FFE4—*Get Character from Keyboard Queue.* Removes one character from the keyboard queue and returns as ASCII value in the accumulator. A 0 is returned if the queue is empty.

$FFE7—*Close All Files.* The pointers into the open file table are reset, closing all files. All I/O channels are also reset.

$FFEA—*Increment Real-Time Clock.* This routine is normally called every 1/60th of a second to update the system clock. If may be necessary to call this routine from a user's program if it processes its own interrupts.

$FFED—*Return X,Y Organization of Screen.* Returns the organization of the screen with columns in X register and lines in Y register.

$FFF0—*Read/Set X,Y Cursor Position.* If carry is set, the current cursor position is returned in the X and Y registers. If carry is clear, the cursor is moved to the position indicated by the X and Y registers.

$FFF3—*Return Base Address of I/O.* Returns the address of the page containing I/O in the X and Y registers.□

Note that addresses are shown in hexadecimal.

```
100 REM ********************************
110 REM
120 REM UTILITY PROGRAM FOR PRINTING
130 REM FORMATTED OUTPUT DISK FILES
140 REM    CREATED BY WORD PRO 3
150 REM   THAT ARE COPIED TO TAPE
160 REM
170 REM          BY: ROBERT BAKER
180 REM   15 WINDSOR DRIVE, ATCO, NJ
190 REM
200 REM ********************************
210 :
220 PRINT"□INSERT TAPE & DEPRESS ANY KEY WHEN READY"
230 GET C$: IF C$="" THEN 230
240 OPEN 1,1
250 PRINT: PRINT"READING FILE..."
260 OPEN 7,4,7: PRINT#7: CLOSE 7
270 OPEN 4,4
280 GET#1,C$: SS=ST
290 IF ASC(C$)=13 THEN PRINT#4,MID$(S$,2): S$="": GOTO 310
300 S$=S$+C$
310 IF SS=0 THEN 280
320 CLOSE 1: CLOSE 4
READY.
```

Listing 3. Utility program for printing formatted output disk files created by Word Pro 3 that are copied to tape.

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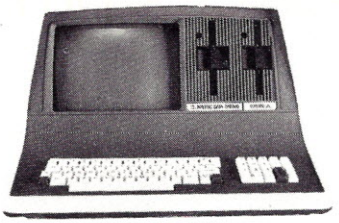

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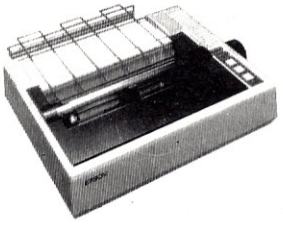

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By Frank J. Derfler, Jr.

Midnight Messenger

Unattended Transmission From Microcom

This edition of Dial-Up Directory marks the second anniversary of the column. Microcomputer-based data communications systems have evolved in a pretty straight line over those two years, but now we are starting to see some branching in the evolutionary tree. This month we'll look at a slightly different kind of electronic mail package, the first commercial adaption of an old idea.

Micro-Courier by Microcom

Micro-Courier is truly an electronic mail package. It provides the Apple II microcomputer with the ability to "wake up" in the middle of the night, dial a phone number, establish contact with another Micro-Courier-equipped Apple II and transfer messages.

In the June 1980 issue of *Kilobaud Microcomputing*, I described a program with similar capabilities called PAN. PAN is still available and costs about $12 on cassette. PAN has never really been commercially marketed. It exists as a project of the Personal Computer Network (PCNET) in Menlo Park, CA. Micro-Courier sells for $250 per copy (you need a separate copy at each end) and it is being heavily marketed.

This idea of unattended message transfer is as old as electronic communications. Before World War II, amateur radio operators developed radioTeletype systems using autostart tones. In response to a clock mechanism, a mechanical teleprinter would key up a radio transmitter, broadcast tones to wake up the teleprinter at the other end and transmit a prepunched message tape.

This kind of message transfer fits well into my concept of electronic communications systems that can break down the Time Tyranny of Telecommunications. Unattended message transfer lets people break away from the need to monitor a telephone or terminal to get a message. Several software firms are developing packages with slightly different unattended transfer capabilities, but Micro-Courier is the first one to be marketed on a commercial basis.

Microcom has a very businesslike approach to their product. They are appealing to the corporate Apple rather than the Apple at home. Technically, the Micro-Courier package is a series of programs on an Apple II disk in DOS 3.3 format. The programs are in assembly language, and Microcom cautions that the disk is uncopyable. They also caution that attempts to copy the disk may result in its destruction. (A real mission impossible?) If you should set your coffee cup on the disk within 90 days of purchase, they will replace it for free. If the disk falls on the floor and you roll your chair over it on the 91st day, it costs you $35 to replace.

The program selection is done through a series of menus which gradually lead you to the operating level. The program asks the user some questions the first time it is run so it knows where to look for the modem, clock and printer cards. It is easy to step down and up the menus to select the function you want. As you step through the menus, the selections you have made are displayed at the top of the screen (rather like a self-documenting game of adventure).

The manual stresses that all you have to do if you get into a problem is hit escape and you'll return to the next higher menu. This works—most of the time.

The program works well doing what it is advertised to do: dropping off messages in the middle of the night when the rates are low. It will do this only with another Micro-Courier-equipped Apple II. Each system should have an Apple II+ or Apple II with Applesoft in ROM, 48K of RAM, a disk system with DOS 3.3 and a Hayes Microcomputer Products Micromodem II. A clock card and two disks are really needed for practical operation. The Micro-Courier disk is nearly full and a separate data disk is needed.

In a typical application, the user creates a message with the Micro-Courier text editor or any editor that will create DOS 3.3 files. Messages can be up to 4000 characters in length. A separate address file tells the system when and where to send specifically named messages. The "where" direction is given as a name or other easily-remembered term.

A separate mailbox ID file matches names to telephone numbers. It is possible to create distribution lists in which many phone numbers are collected under one ID. At the assigned time, the Apple II dials the number and transmits the specified message. It transmits one file per call. The program is not smart enough to ask if the called station has any mail coming back. The program will repeat unsuccessful attempts to deliver a message, and logs of outgoing and incoming messages are maintained.

Micro-Courier does have an interactive terminal mode, but this mode is quite difficult to use. The terminal mode has 22 lines available for the display of received data. The screen displays modem and file status in five lines at the top, and three lines of special commands you need to know are displayed at the bottom.

Unfortunately, the incoming data overwrites the first line of commands on the bottom of the screen and the rest of the information loses meaning.

This is particularly tricky because in this program ESCAPE does *not* work. You could pound the escape key all day and not get to a higher menu. It also doesn't help that when two Micro-Courier-equipped Apples are in the terminal mode, neither one echoes the other. That means you can't see what you are typing, unless you both work your way back up through two menus and select the full duplex mode. You are much better off dumping the Micro-Courier software and just using the Micromodem II ROM program if you simply want to operate in the terminal mode without exchanging files.

Micro-Courier has been heavily advertised and its slick packaging matches its advertising. The manual contains 164 pages of text with a very good index and a small glossary. It contains illustrations of the keyboard and screen displays. The

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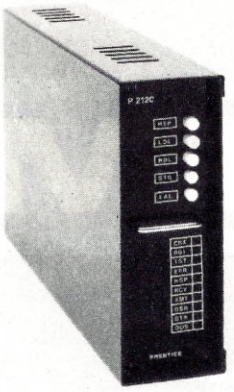

The Prentice P212C is a microprocessor-controlled modem capable of 300- or 1200-bits-per-second operation. The first button on the right selects high- or low-speed operation. The other buttons select various test modes. Extensive diagnostics are built into this well-engineered device.

discussion in the manual is done at the most elementary level. In fact, the entire packaging concept of the program, from the multiple menus through to the language of the manual, is aimed at the novice user.

That's acceptable, but experienced users can get pretty exasperated with rigid menu structures and the need to wade through lines of explanation to find a specific command. In Microcom's defense, they did provide a stick-on guide to the commands used in the editor program, but a separate instruction card summarizing all the commands would be valuable.

I believe that if Microcom is going to be successful in the corporate market, they have some work to do. One disk I received for evaluation had a bad sector and would not load the editor. The other package had an instruction manual with many of the pages uncut. But primarily, I feel the program needs some way of performing a quality-control check on the messages it transmits. Not all long-distance phone lines are created equal, and it is often worse to transmit garble than never to have transmitted at all.

Significantly, microcomputer programs exist which perform very nice line testing and transmission validation. The ST-80 software series written by Lance Micklus has a line-testing and character echo-check feature. Many programs like Crosstalk provide a protocol file transfer which ensures accurate transmission. Micro-Courier has none of these features. It is an expensive program with limited applications.

Dow Jones

The mailbag has reminded me that I have never mentioned the Dow-Jones Information Service (DJIS), which is available to microcomputer data communications users. This service has a higher hourly rate than either The Source or CompuServe, but if you are a serious stock investor it provides lots of useful information. DJIS provides information on over 6000 stocks and securities listed on the New York, American, Midwest and Pacific stock exchanges and the over-the-counter market. If you live in a part of the country without a good newspaper, or if you like to follow "penny stocks" or over-the-counter stocks, this feature could be handy. All listings are delayed 15 minutes, but for 99.99 percent of us that represents real-time information.

DJIS has an involved pricing structure that depends on both the time of day and the kind of service used. During non-prime hours, using the price quote function can cost 15 cents per *minute*. Use of the historical Media General information file costs $1 per minute during any time period. (Obviously, you don't want to browse too long.) The non-prime hours change with the time zones. The Pacific time zone is only non-prime from 8 PM until midnight. The Eastern time zone gets the low rates from 8 PM to 3 AM.

I find the historical information the most valuable feature of the DJIS. You can get good information on price-earnings ratios, price performance vs market performance and many other features. In addition, news stories and financial information are available from the *Wall Street Journal* and *Barron's*. Most people would find it more economical to get the general news from the financial journals and just use the DJIS for research on specific issues. The news stories do have a subject search capability and can present a summary of the article.

Anyone interested in the Dow-Jones Information Service should note that Radio Shack is offering one hour of DJIS time in their CompuServe membership packages. You get a binder with system information, membership on CompuServe and an hour of user time on both CompuServe and DJIS for $19.95 (order catalog no. 260–2224).

You don't have to use a TRS-80 computer to take advantage of this package; any computer or terminal with communications capability can be used.

Videotex software packages for the TRS-80 Model I, Model II, Model III and Color Computer are available for $29.95 at Radio Shack. These packages also include one hour on CompuServe and DJIS. The cassette-based Vidtex programs (the program name is slightly different from the package name) are easy to use and nicely integrated into the CompuServe and DJIS formats. They all allow interfacing with a printer to provide hard copy of the received information, but of course they don't let you create data files. You'll

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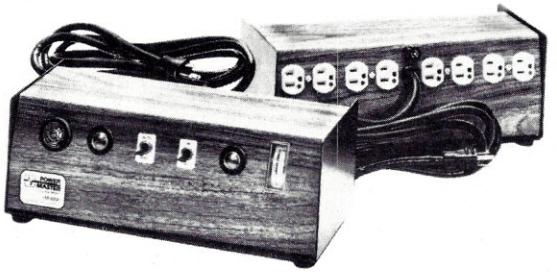

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need a more advanced terminal program to save the received data in files.

The Dow-Jones Information Service isn't for everyone but those who can use it will find it invaluable. The Radio Shack CompuServe membership package gives many folks the opportunity to try the DJIS at a reasonable price.

The Prentice P212C

You can lease a 212A 1200 bits per second modem from your local telephone company. It will cost you about $40 a month plus an installation charge of $80 or more. This installation usually includes an improved line from your location to the telephone office and a telephone instrument with a modem/voice switching arrangement.

Alternatively, you can buy your own 212A modem. You might do this if you are in a business and want to depreciate the equipment, or if you simply want to avoid the monthly payments. Let's take a look at the state of the art in 212 modems. I want to introduce you to one of the most sophisticated 212A modems, the Prentice P212C.

The P212C is a microprocessor-controlled device which will operate at 300 bits per second as a Bell 103 standard device and at 1200 bits per second using the 212 standard. It connects to the computer or terminal through a standard RS-232C cable. It will auto-answer and adjust itself to the speed of the calling party.

This is a commercial-quality device built in a heavy metal cabinet with a husky power supply. It has a commercial retail price of about $800. The P212C will do many nice things for its user. It features five different types of loopback circuitry including separate local tests of the analog and digital sections of the modem and tests which show the quality of the telephone circuit with the cooperation of the modem at the other end.

A 212 standard modem can be used over average telephone lines, but you get more reliable operation if you ensure that the signal levels transmitted and received by the modem fall within certain limits. Signals with levels too high or too low can easily cause errors in the four-level phase-shifted keying scheme used by 212 modems.

Proper installation requires a padding resistor in the telephone coupler or connecting cable to fine tune the audio level with the telephone office. Prentice can provide various cables to connect the P212C to the telephone system. A "permissive" cable lets you plug the modem directly into any standard voice jack. But the use of a standard jack is the easiest (and cheapest) method of installation. It will usually work, but the error rate depends upon the conditions between your telephone and the central office.

Marketing Advice

Prentice has obviously targeted the commercial market with this high-quality device, but with a few changes they could open the small computer market too. A plastic cabinet and elimination of the fancy test features would be the first step. I would reassign the five buttons on the front as on/off, 300/1200 bits per second, orig/ans, half/full duplex and in/out.

If they could sell the consumer model P212XX at $400 they would have a big place in the market. In the meantime, if you want to put some zip in your data communications, the Prentice P212C provides a well-engineered and reliable way to do it. Contact the Prentice Corporation, 266 Caspian Drive, Sunnyvale, CA 94086.

Your Help

This column would be much harder to write without the tidbits and tantrums I receive from readers. If you want to help make the third year of Dial-Up Directory even better than the first two, your news and views are needed. Send paper mail to PO Box 691, Herndon, VA 22070. Include a stamped envelope for replies. Send electronic mail to TCB967 on The Source, 70003,455 on CompuServe, or the AMRAD CBBS, 703-734-1387.□

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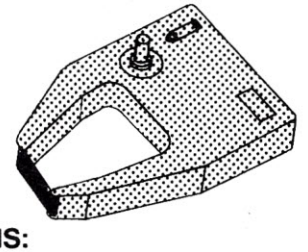

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By Walter Koetke

Poor Marks For Software

Hardware Is A Terrible Thing To Waste

The entrance of microcomputers into the country's classrooms has grown from a trickle to a roar. Will we soon see a flood? Is the microcomputer a soon-to-be-forgotten technological fad? Is it an ideal instructional tool? I'll discuss these and other questions as this column assesses the microcomputer's impact on instruction and then projects that impact into the near future.

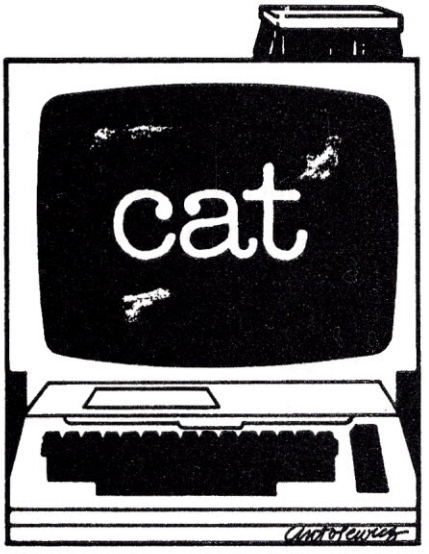
What's Happening Right Now?

As in so many application areas, the gap between the potential and the reality of microcomputer software is enormous. This gap reminds me of the story about the German poet who was asked where he would choose to live if he knew the world was about to end. After very little deliberation, he responded that he would live only in England. Many were surprised by his rapid, decisive response. When his decision was questioned, he responded that England was a perfect choice because England has always been 100 years behind the rest of the world.

While the analogy is not perfect, the state of today's software does indeed trail the potential of today's hardware by many years. This is not news to those in the computer industry, but it is both news and a huge disappointment to educators who've only read of the computer's potential before finding a microcomputer in their classroom.

Colleges and universities are not yet in a position to help educators with their current and short-term needs for assistance. While there are certainly a few exceptions to such a general statement, the number of colleges able to offer teachers no more than FORTRAN, COBOL, assembly-language programming, or something equally inappropriate is distressing. The number of well-publicized but rarely open or accessible microcomputer laboratories and well-

Walter Koetke, Putnam/Northern Westchester BOCES, Yorktown Heights, NY 10598.



funded software evaluation centers that just can't manage to produce evaluations is also distressing.

Perhaps such situations are unavoidable aberrations of rapidly changing technologies and honest intentions that badly underestimate the magnitude of the task at hand. Although the situation will eventually evolve into a more acceptable state, it is unfortunate that the vast majority of colleges and universities have been unable to respond to a readily definable, nationwide need.

Educators have become increasingly receptive to the idea of using microcomputers for instruction. The lack of support materials coupled with the ideas already discussed has often resulted in frustration. However, many educators have also become more sophisticated in their evaluation of microcomputer software and hardware. While they readily admit their knowledge is inadequate, there is movement in the right direction.

Part of this movement is the result of the evolving technology. Now that several microcomputers popularly used for instruction have been replaced by newer, only somewhat compatible models, educators find themselves in a position of defending earlier purchases of what is now being incorrectly called "outmoded" equipment. For those who properly prepared for their initial purchase, this defense is trivial. For those who were not so well prepared, the defense has necessitated an overdue crash course in computer literacy.

Educators are beginning to realize the disadvantages of basing their local programs on a single brand of microcomputer. The advantages of a single-brand commitment are far outweighed by the disadvantages. For example, my choice for the ten best pieces of instructional microcomputer software involves four different microcomputers. Having only one brand available is a major restriction. Microcomputers are big business, and vendor stability cannot be assumed. Many sales and a few good products are not a guarantee that there will be a tomorrow. Explaining to a school board that the company who sold you all the microcomputers is out of business and the machines can no longer be serviced is not an enviable position, yet I suspect that is where many responsible for one-brand commitments will find themselves. For these and other reasons, educators seem to be broadening the base on which they're developing instructional programs.

IBM and Education

A look at today's role of microcomputers in instruction would be incomplete without acknowledging that industry continues to call many shots for education. Although clever advertising agencies would have us think otherwise, improving instruction is foremost in almost no one's mind as new products are conceived and developed. This is actually quite reasonable, just unfortunate. When you compare the size and available cash in the marketplaces, small business, education and home educators always finish last. When the cost of dealing with the marketplaces is also considered, the spectators have lost interest

and gone home before educators finish the race.

Some months ago I had the opportunity to hear a discussion of research regarding reading comprehension. I liked many aspects of this presentation, including the fact that a microcomputer was only one of several tools being developed for the classroom teacher who must teach reading comprehension. An experienced, thoughtful researcher from IBM's Watson Research Laboratories, New York, made the point that research indicates two essential features for instructional microcomputers are voice output and touch-sensitive screens. The importance of color was unclear, since the research presented did not indicate that color would or would not significantly enhance instruction.

Shortly after this presentation, IBM announced its new Personal Computer, a machine with a very impressive list of features, including excellent color, but without voice output and a touch-sensitive screen. IBM has produced an excellent product, but the education marketplace was not high on its list of development priorities. The Personal Computer does not provide those features which IBM's own research considers essential for instruction.

Next time you hear someone moan that education should make as effective use of microcomputers as does small business, remember that the small businessman can select hardware and software packages designed with the needs of small business in mind, while educators are often faced with the task of selecting the best of what was designed for someone else.

As a final general observation, the instructional use of microcomputers seems to be moving away from the "local hero" doing his or her thing to a more structured system-wide approach. This follows quite naturally as administrators become uncomfortable with a proliferation of hardware without someone providing coordination and direction for its use. The same phenomenon is happening at the state level. With at least one state reporting that 95 percent of its public schools provide computing facilities, there are several states attempting to form minimum standards, create computer literacy objectives, set microcomputer standards and offer other evidence that they're on top of things.

It's significant that 12–18 months ago you could survey microcomputer use by calling a school district's central office for information. That is not often the case at present. Now such a survey would require a call to each building. Whatever the reason, I believe the growth of local "computer coordinators" should assist other educators as they too begin to use the computer to support instruction.

Let's focus on the evolution of microcomputer hardware as it pertains to instruction. As already mentioned, IBM has entered the marketplace with a well-designed personal computer system. It has done so in a manner that illustrates the rapid change of the industry. The new IBM Personal Computer is its first "integrated" system, which means IBM has put its name on products produced by others. The IBM Personal Computer will be offered with software developed by others and marketed through Sears and other nontraditional outlets. The point is that the rapidly changing technology has put an industry leader in a position of catching up. I suspect it will do just that, since the IBM Personal Computer seems to have all the good features of the competition plus several terrific extras, an excellent service plan and a name that won't do any harm.

The IBM Personal Computer will have little direct impact in the education marketplace. Too many schools still purchase the least expensive machine and then later worry about software and other forms of support. The chances of large numbers of schools adopting one of the most expensive machines is extremely remote.

On the other hand, I suggest that IBM's Personal Computer will have a significant indirect impact on instructional microcomputers. As IBM establishes itself in the business market, it will do so partly by expanding that market, but also at the expense of current entries in that market. Should IBM seriously affect the market share of Tandy, Apple or Commodore, that impact is bound to be reflected in the educational marketplace. The next 12 months should be very interesting.

> Educators are often faced with selecting the best of what was designed for someone else.

Why BASIC?

There are well-known and respected educators, including Seymour Papert, who contend that BASIC is not just a poor choice, but an impossible choice for many children. We don't use BASIC as the result of any research on learning or instruction. We use BASIC because that's what the computer industry chose to provide.

Logo is now available for the Texas Instruments 99/4A personal computer (versions for the Apple and Atari are expected to be released soon). If you're concerned with computer use in grades K through 3, you can do no better than Logo. If you don't have a TI computer already—an extremely likely possibility—then here's your opportunity to demonstrate some of the merits of having more than one brand of microcomputer.

Try the following on your micro or even minicomputer.

```
10 FOR C = 1 TO 100 STEP .1
20 PRINT I
30 NEXT I
```

I've run this on a great many computers of all sizes, and the TI 99/4A is only one of two computers that properly execute the program. There are several other standard examples of annoying round-off error that can be executed without error on the TI 99/4A. The ability to avoid such errors is a strong plus when dealing with younger children.

Another piece of hardware that seems to be slow getting off the ground is the Radio Shack Color Computer. With a 16K memory and Extended BASIC, this is a very nice instructional machine that hasn't found its way into many classrooms. That might be attributed to the huge lack of instructional software. As of this writing, even Radio Shack was offering only three packages that might be considered useful for instruction. A significant step for this computer is the availability of a disk drive. A complete system with disk costs about $1500. This configuration has nearly all the ingredients for becoming a winner in the education market. I suspect, however, that this will not be the case.

Two of the reasons for my suspicion are the Atari 400 and 800 coupled with Atari's somewhat recent decision to actively pursue the educational marketplace. While other vendors are certainly interested in the educational marketplace, Atari is the only major hardware vendor that has targeted school and home applications as a primary rather than secondary objective.

That Atari is serious in this commitment is evidenced by their recently being awarded the MECC (Minnesota Educational Computing Consortium) microcomputer contract for the next three years. This contract was awarded to Apple for the preceding three years, and that contract and ramifications of it went a long way toward establishing Apple's niche in the education market. As the MECC contract includes the translation of nearly 100 programs to the Atari, this newcomer will have a very sound software base of interest to many schools.

An assessment of today's educational hardware would be incomplete without mentioning the Apple II and TRS-80 Model III/Model I. Certainly these machines are the dominant factors in today's educational market, and there is some excellent software available for each of them. Dollar for dollar, the disk-based Model III is hard to beat for a general-purpose application at home or school. Should Radio Shack lower the price of the disk and/or disk controller for the Model III, they may well continue their

dominance in the market.

Where does all this hardware leave the teacher? Are there some clear, unchallengeable choices of hardware? You must carefully evaluate how your application would be best implemented on the personal computers discussed. Just be sure that if your application includes the use of prepackaged software, then use that software once or twice before buying the hardware. Most dealers are more than happy to accommodate a reasonable request such as this if your decision to purchase hardware really does ride on the outcome.

As schools consider additional hardware purchases, I suggest they carefully consider the experience of others. Bargains are not always what they seem. For example, in which marketplace do you find cassette-based systems? The answer is in the hobbyist and school market. Business has never taken a cassette-based system seriously.

As educators have become familiar with the advantages and disadvantages of various microcomputers and peripherals, they've realized that the disadvantage of initial cost of a disk may well be offset by the many user advantages. Cassette-based systems really aren't appropriate for other than beginning programming classes. There are certainly some successful applications in other circumstances, but I suggest such success is achieved in spite of, rather than with help of, the hardware. You can't help but notice that as the market is becoming saturated with cassette-based systems, at least two major manufacturers have announced notably lower-priced disk systems.

Cassette-based systems really aren't appropriate for other than beginning programming classes.

Educators should reconsider any decision to purchase other than disk-based microcomputers for instruction. If you've just a small amount of money, add a disk to your present cassette system. The only exception would be the TRS-80 Model I. That is best left alone, since the newer disk systems are vastly improved on the Model III as well as on other brands.

The rapid proliferation of microcomputer hardware in schools continues at a rate that parallels or exceeds the proliferation in other areas. Whether this proliferation is good or bad may be debatable, but its existence is fact. There is a statistic somewhere that says 80 percent of the scientists that ever lived in the world were alive in 1960. In a similar manner, I believe more computers were sold during 1981 than were sold in all previous years. There is every reason to believe that this same outrageous rate of growth will continue. The impact on education will certainly be even larger, but the nature of that impact has yet to be well defined.

Next month I'll continue to explore the current state and near future of instructional microcomputing, with the emphasis on software and advice regarding future planning. □

MICRO QUIZ

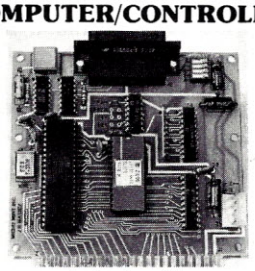
What Does This Program Do?

If the following program is executed with L$ = "you," what will be the final value of P? (An underscore represents a blank.)

```
S$ = "ask_not_what_your_country_
  can_do_for_you,_"
S$ = S$ + "ask_what_you_can_do_
  for_your_country"
P = 0
for J = 1 to (len(S$)-len(L$))
    if mid$(S$,J,len(L$)) = L$ then P = J
next J
```

(answer on page 153)

Z8 BASIC COMPUTER/CONTROLLER



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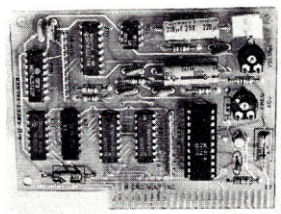

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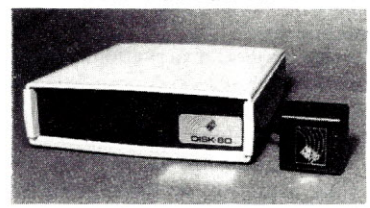

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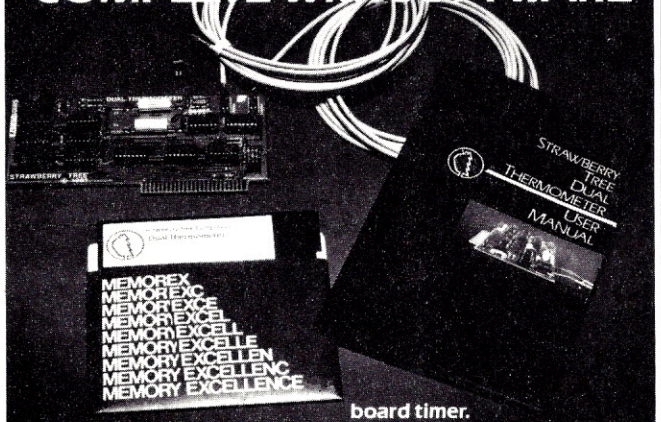

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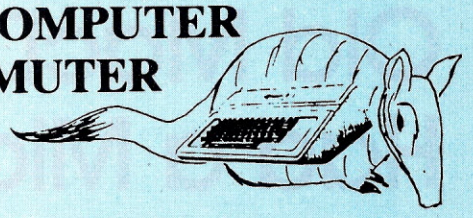

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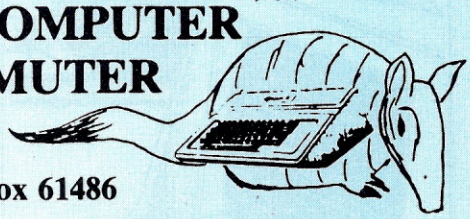

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Compiled by Eric Maloney

Old MacDonald Had a Micro

And He's Using It To Call Up Videotext Services

Harvesting Data

Farmers, agriculturists and extension agents in the U.S. and Canada are making use of several specialized videotext services now on-line.

These services can provide a wide range of information, from current market statistics to encyclopedic data on crop pests. They include the Kentucky Cooperative Extension Service's Green Thumb project, Instant Update from Professional Farmers of America in Cedar Rapids, IA, Elanco's Agrivision, Project Grassroots in Manitoba and SCAMP in New Hampshire and New York.

While they vary in size and scope, all use videotext technology, transmitting data via telephone line to a terminal or microcomputer.

The most popular type of videotext service so far is based on the Green Thumb project at the University of Kentucky. For that pilot test, Radio Shack developed a keypad which eventually evolved into the Radio Shack Videotex terminal. The project now also uses a TRS-80 Model II to collect and transmit data. The system has been adapted for use by Instant Update and Agrivision.

The initial phase of the Green Thumb project ran from March 1980 to December 1981. In January the Kentucky Extension Service moved into phase two, which was to establish Green Thumb as a permanent service. At first, some 200 farmers in two counties were able to access the service. In phase two, the service has been opened to the entire state.

Users can retrieve information in 17 categories, which include weather, market news, county news, pest management, agriculture economics, animal sciences, entomology, forestry, horticulture, plant sciences and veterinary medicine. The market and weather information is updated automatically; other categories are updated weekly or monthly.

The system consists of a TRS-80 Model II and an eight-line multiplexer. The service is free, except for phone charges. Eventually, different parts of the state will have their own store-and-forward units, thus allowing farmers in each area to access the service with a local call.

While the Cooperative Extension Service provided the keypads for the pilot, farmers will now have to buy their own terminals or microcomputers. John Ragland, assistant to the director, says that software is available for the TRS-80s, the Apple and the TI 99/4.

Ragland expects that about one-third of the initial users will stay with the system, with perhaps a total of 200 users by next July. That number could multiply two or three times by mid-1983.

Instant Update

Instant Update is modeled closely after the Green Thumb project, and is the first commercial pay-as-you-go farmers' videotext service. It serves largely the Midwestern farm states, although it has subscribers in nearly all 50 states.

The core of Instant Update is an electronic newsletter that provides such ephemeral information as market news, commodity prices, marketing tips and the weather. Its features include:

- current future prices for grains, livestock, cotton and gold;
- a cash market scan that tracks the difference between cash and futures at key points for major crops;
- price chart trends;
- Washington Watch, for news from Pro Farmers' Washington bureau;
- a commodity-by-commodity summary of Pro Farmers' marketing plan;
- current recommendations on market tactics;
- local, national and world weather.

Instant Update currently has some 600 subscribers. "We consider that to be pretty good, even though it's not what we'd hoped for," says Marketing Manager Stewart Cross. Subscribers pay $95 per month, plus toll charges. Cross says

the average subscriber calls twice a day and spends about $30 a month on phone calls.

Instant Update subscribers originally were able to access the service only with a Radio Shack terminal. Pro Farmer has since developed software for the Apple, and is working on software for the TRS-80s.

Similar to Instant Update—in fact, Pro Farmer provides the editorial material—is Agrivision. Agrivision is provided by Elanco as a service to buyers of its herbicide treflan. Farmers who buy at least 250 gallons a year receive a terminal similar to the one used by Instant Update. The information, while similar to Instant Update's, is geared toward soy bean and cotton farmers in the South. So far, some 2000 units have been installed.

Except for phone charges, the service is free. Elanco provides the database partly to support its image as a "leader in innovation," says Roger Benson, manager of managerial services.

"Hopefully we'll gain a certain amount of market loyalty," he says.

Canada's Telidon system made its agricultural debut in mid-1981 with Project Grassroots in Manitoba. Growing out of the Project Ida field trial in South Headingley, near Winnipeg, Project Grassroots is a joint undertaking of InfoMart and the Manitoba Telephone System.

The project started off with 25 terminals in such public places as the offices of grain elevator operators, crop insurance agents and agricultural agents. It has since expanded to include 25 farm homes and 25–30 commercial subscribers, and InfoMart Branch Manager Bruno Leps hopes for 500 more terminals by early 1982 and 1500 more during the year after that.

Project Grassroots includes some 3500 pages of agricultural information. Included are the Winnipeg Commodity Exchange; the World Weatherwatch; information on home economics and farm safety; Current Focus, a service to provide regular updates on the market outlook for grain, livestock, dairy and poultry producers; the Herald Grain Newsletter, on grain industry activities for the week; statistical reports from the Canadian Grain Commission on the supply and movement of Canadian grain; and information on livestock markets.

To access Project Grassroots, the user needs a Telidon keypad, developed by Norpak, and the Telidon terminal from InfoMart. The user pays $47 a month for the terminal on a two-year lease, and pays five cents a minute for telephone charges. Leps says that the average user spends ten to 20 minutes a day on the system, with monthly charges coming to about $80.

One of the outstanding characteristics of Project Grassroots is its graphics displays. Grassroots pages often include colorful illustrations, charts and maps.

The SCAMP system differs from the others in that it is currently geared primarily toward extension agents, agriculturists and foresters. It provides pest and crop management information, which is routed through the state extension agencies to the farmers.

The New Hampshire SCAMP program has some 60 users, most of whom are extension agents, University of New Hampshire personnel and foresters. But, says UNH Extension entomologist James S. Bowman, the long-range plans are to include individual farmers.

"There's no reason why a farmer couldn't hook up to the system if he had a coupler and terminal," he says.

The two most important features of SCAMP are its electronics bulletin board system and its library. The bulletin board includes field reports from SCAMP users on current pest problems and recommendations on how to deal with them. The library includes the life histories of a variety of crop pests, and information on their control.

Bowman is pleased so far with the system's development.

"The mechanics are good, and the software is fine," he says. "We just have to get people to use it more. The younger extension agents are embracing it, but some of the older agents are a little hesitant."

Market Strategies

To whom are these systems geared, and what is the potential market?

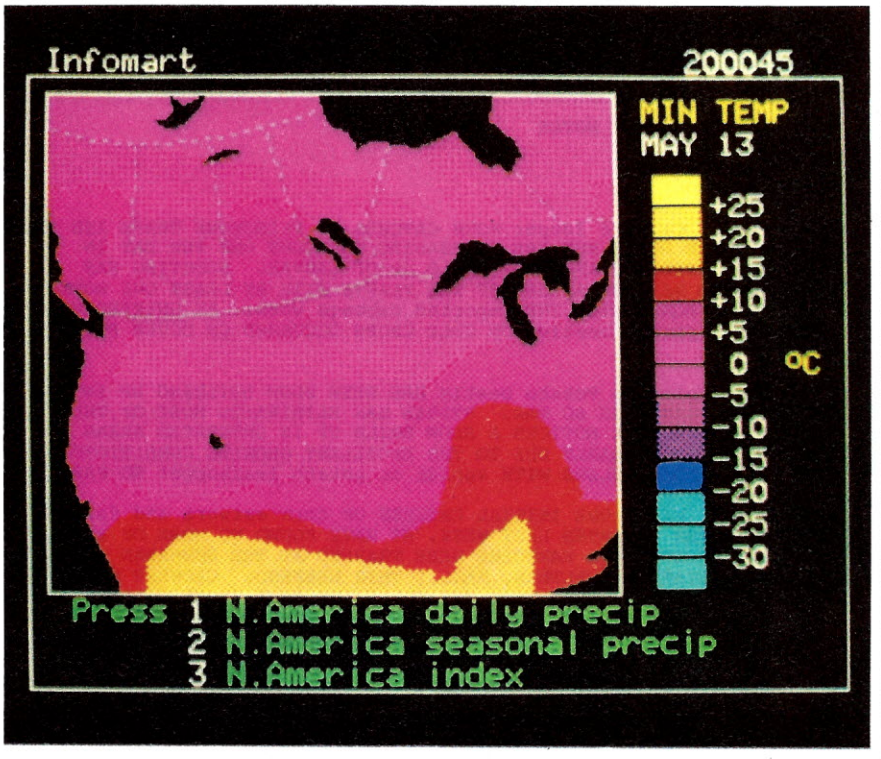
So far, the commercial services are appealing to owners of larger farms. The average Instant Update subscriber, for instance, runs a 700–800 acre farm, substantially above the national average of 430 acres, and spends about $125 a month on the service. Elanco subscribers receive the service free, but the 250 gallons of treflan they buy costs over $6000 and is enough to treat 1000 acres. Bruno Leps says that Project Grassroots, too, is geared toward the larger farmer.

"This is not to say that there's not a market for others," he adds. "But we're going to have to bring the price down first."

The cost, however, is not the major factor, says Green Thumb's John Ragland. The costs for a terminal are within the reach of even the small farmer. "But you have to have some size before you start trading grain and livestock," he says, noting that marketing information is the most-used service of Green Thumb.

"It doesn't have to be the case that we're used only by larger farms," he continues. "If we get a bulletin board system, if we're imaginative and aggressive, we could come up with a service of value to small farmers, too."

Nevertheless, it is true that many small farmers are currently struggling for survival. According to figures from the U.S. Department of Agriculture, 102,000 farms have shut down in the U.S. since 1975, though the average size has increased from 420 to 430 acres. Many small farmers might not be willing to pay for a service like Instant Update, when they can get much of the same information in periodicals, on the radio and through the local extension agent.



A page from Project Grassroots, an agricultural videotext service in Manitoba, Canada.

A recent survey by *Successful Farming* magazine of its readership shows that 31 percent of those questioned are not interested in a videotext service. Some 41 percent said they are somewhat interested. Only 27 percent said they are interested or very interested. While this figure translates into some 650,000 potential subscribers—more than enough to make services like Instant Update commercially viable—it indicates that the majority of farmers will continue as they have for a while longer.

Bringing down the costs of videotext services will no doubt help. As Ragland points out:

"Farmers have traditionally had technology and information provided in fairly good quality and quantity for low cost, through extension agencies and the federal government. It's a fact that leads me to believe that we should look at alternative means of providing the information without charging the farmer a user's fee."

Several ways of doing this present themselves. Some companies could go the route of Elanco, offering videotext services as premiums to customers. Another possibility is sponsorship of databases by commercial businesses, an option Green Thumb is considering.

"For example, it might be a local county bank," Ragland says. "They may support a service in exchange for a page of information on their interest rates or services. It may be that there might have to be advertising, or at least recognition of sponsorship."

We should look at alternative means of providing the information without charging the farmer a user's fee.

Finally, extension agencies might act as clearinghouses for farmers in their area, as is the case with SCAMP. Farmers would call their local agent with questions, and the agent would access the information from the host computer.

Until the costs decline and services become accessible to a broader range of farmers, videotext services will be scrambling to convince their potential market that they have a valuable product.

"Videotext is limited by how good the information is," Roger Benson of Elanco says. "As long as it's expensive to access the information, it has to be worth the customer's while."

—Eric Maloney

More on Woman Computerists

Microcomputing and the Association of Women in Computing have received a number of queries concerning an article on that organization (see "Women, Unite!" on p. 28 of the October issue). Following is a list of chartered or provisional AWC chapters:

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Bellevue, WA 98008

Women who are not near a chapter can get a list of members in their immediate areas by writing National President Linda Taylor, 3573 Greenfield Ave., Los Angeles, CA 90034 (213-557-8797).

The AWC was formed to support women in computer fields with career counseling and a network of job contacts, as well as seminars, workshops and scholarships.

```
=>VEGETABLE
 HOW MANY DAYS TO REPORT?
=>7
08/ 12/ 81  FROM: NEWSLETTER
TO: FIELD

FROM 8/11/81 INSECT NOTES

   VEGETABLES
(Bowman, Eaton)

Cole Crops:  Cabbage looper MOTH CATCHES IN PHEROMONE TRAPS ARE STILL
ZERO ON DOVER POINT BUT ARE INCREASING TO ABOUT ONE PER DAY IN
STRATHAM.  STILL NO APPARENT BUILD UP OF LARVAE.  SCOUTING HAS
DEMONSTRATED AS HIGH AS 56% OF THE PLANTS WITH AT LEAST ONE WORM
WHICH IS PREDOMINANTLY THE Imported cabbage worm.  AN UNEXPECTED
ATTACK BY Japanese beetles ON COLE CROPS OCCURRED ON DOVER POINT
THIS WEEK.

Potatoes:  Colorado Potato beetle HAS BEEN SLOW BUILDING UP IN
COMMERCIAL PLANTINGS SO FAR.  PYDRIN HAS ELIMINATED MOST OF THE
PROBLEM BUT WE HAVE NOTICED A SLOW BUILD UP IN UNTREATED AREAS
ALSO.  THIS IS PROBABLY DUE TO THE EXCELLENT GROWING CONDITIONS
THIS YEAR.  NO PROBLEMS WITH aphids or potato leafhopper SO FAR.

Sweet corm:  SINCE OUR INITIAL CATCHES OF corn earworm and fall
armyworm MOTHS REPORTED LAST WEEK, WE HAVE FOUND NO MORE OF EITHER
SPECIES.  A COUPLE OF EARWORMS WERE TRAPPED AT THE SUBURBAN
EXPERIMENT STATION (WALTHAM, MASS.) THIS WEEKEND.  GROWERS WITH
LIGHT TRAPS MUST BE SURE THAT THE TRAPS ARE KEPT CLOSE TO FRESH
SILKING CORN, IF EARWORM CATCHES ARE TO BE RELIABLE.  European
corn borer CATCHES ARE STILL HIGH.  WE STILL RECOMMEND ABOUT A
6-DAY SCHEDULE FOR SILKING CORN, BUT THAT CAN CHANGE IF earworm
or fall armyworm COUNTS INCREASE.

END
```

From the electronic bulletin board of the University of New Hampshire's SCAMP system.

The Rich Get Richer

The affluence of a school and its community is the most important factor in whether a school uses computers for instruction, says a recent study by Market Data Retrieval of Westport, CT.

The study says that 46 percent of those school districts spending over $75 per student for instructional materials have instructional computers as compared to 20 percent of those spending under $30 per student. Thirty percent of the schools in upper income areas use computers for instruction, as compared to 12 percent of low-income area schools.

The study also reports that of 15,442 U.S. school districts, 6441, or 42 percent, use instructional computers. Also, 15,918 of 84,226 public school buildings—or 19 percent—have classroom computers.

Grade level and size of the school are also factors. Some 43 percent of senior high schools, 26 percent of junior high schools and 12 percent of elementary schools use computers. Almost 60 percent of high schools with over 1000 students have computer-aided instruction, as compared to 24 percent of small high schools.

World Book On Line

The CompuServe Information Service will soon be offering an electronic version of the World Book Encyclopedia to its subscribers.

The encyclopedia, which is still in the developmental stage, will offer the basic editorial content of the printed version, as well as several enhancements.

"As the project develops I wouldn't be surprised if the encyclopedia includes extras, in the form of customer feedback where they could ask questions," says Richard A. Baker, CompuServe's editorial director. "Or World Book may break out certain sections of the Encyclopedia to be continually updated and revised."

This latter feature, he says, could provide current information on rapidly changing events in the world.

Baker says that these possibilities are based on the kinds of services other information providers like to include.

No date has been set for start-up of the encyclopedia.

A Boost for Atari?

Atari is going to give Apple and Tandy some stiff competition as a result of Sears' and IBM's decision to sell the 800 in their business machine stores, says a recent report from International Resource Development, Inc.

The report says that Atari, a division of Warner Communications, has recognized the importance of reaching the business market, and will thus gain a significant market share.

Throw That Kid an Atari

Twenty-one outstanding freshmen at Rensselaer Polytechnic Institute in Troy, NY, have received Atari 800 computer systems as part of an academic scholarship program.

The winners—15 men and six women—were chosen on the basis of academic achievement and Scholastic Aptitude Test scores. Their SAT averages were 732 out of 800 for verbal and 761 of 800 for math.

The students can use their micros for special projects and compete for a $1000 prize to be awarded at the end of the academic year.

The Ataris will become the students' personal property when they receive their undergraduate degrees.

RPI has developed an extensive computer education program, which includes an IBM 3033 mainframe and 400 terminals on campus.

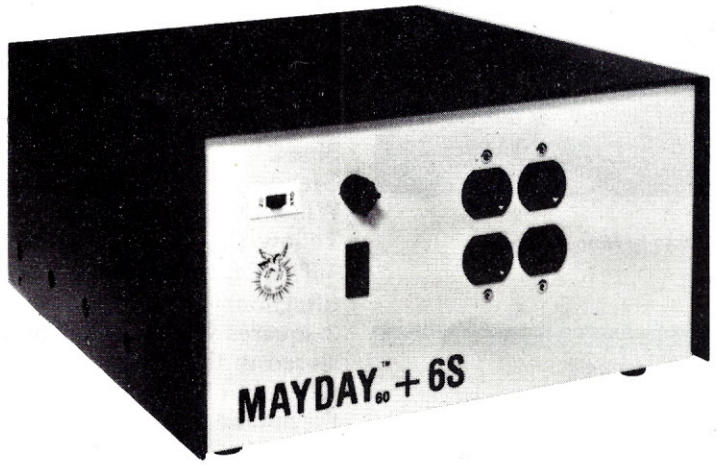
New Mag for Big Blue

IBM's new Personal Computer was barely on the loading docks when Software Communications, Inc., revealed plans to launch a magazine for the computer.

PC, billed as "the independent guide to the IBM Personal Computer," will be piloted by David Bunnell. Bunnell, who most recently was managing editor at Osborne/McGraw-Hill, was also editor at one time of *Personal Computing* magazine, and has coauthored a book with Adam Osborne called *A Beginner's Guide to Microcomputers.*

Software Communications gave no date for publication of the new magazine.□

Introducing.....



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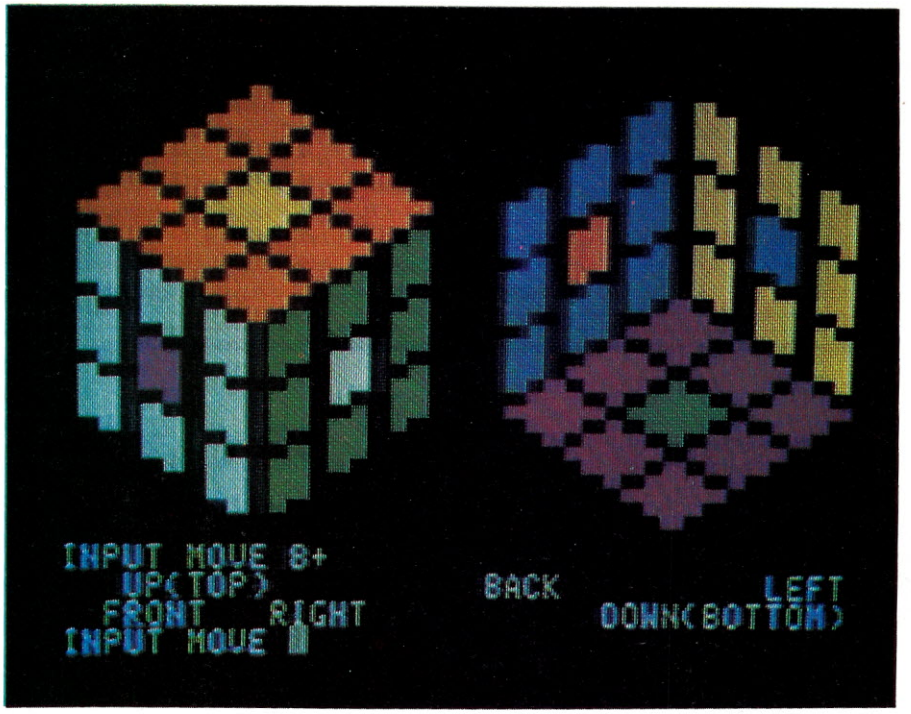
With practice, you can master Rubik's Cube with this Apple simulation program.

Rubik's Cube Demystified

By Curtis and Lillian J. Cooper



Screen display of the Applesoft Rubik's Cube program. (Photo by Harold Nelson)

This program, in Applesoft BASIC using low-resolution graphics, simulates Rubik's Cube. The problem is to take any arrangement of the cube and restore it to its pristine state.

In solving Rubik's Cube, each face on the cube can turn clockwise or counterclockwise. In addition, different views of the cube are obtained by rotating the cube about axes through the center squares of the top and bottom faces, right and left faces, and front and back faces.

Program Notes

The program uses an array R, dimensioned to 5 by 5 by 5, as its representation for Rubik's Cube. Colors are stored numerically as follows:

Magenta 1
Orange 9
Blue 2
Green 4
White 15
Yellow 13.

The F face (see photo for face identification) is stored in the middle 3 by 3 squares where x = 1. The R face is stored in the middle 3 by 3 squares where y = 1. The D face is stored in the middle 3 by 3 squares where z = 1. Similarly, the B face is stored in the middle 3 by 3 squares where x = 5; the L face is stored in the middle 3 by 3 squares where y = 5; and the U face is stored in the middle 3 by 3 squares where z = 5.

Program listing. Rubik's Cube simulation in Applesoft BASIC.

```
10  PRINT "THIS PROGRAM SIMULATES RUBIK'S CUBE"
20  REM
30  REM   INITIALIZE RUBIK'S CUBE
40  REM
50  DIM R(5,5,5),R1(5,5,5),A(5,5),B(5,5),C(5,5),D(5,5)
60  FOR I = 1 TO 5: FOR J = 1 TO 5: FOR K = 1 TO 5
70 R(I,J,K) = 0
80  NEXT K: NEXT J: NEXT I
90  FOR I = 2 TO 4: FOR J = 2 TO 4
100 R(1,I,J) = 1:R(I,1,J) = 15:R(I,J,1) = 4
110 R(5,I,J) = 9:R(I,5,J) = 2:R(I,J,5) = 13
120  NEXT J: NEXT I
130  REM
140  REM  MIX RUBIK'S CUBE
150  REM
160  INPUT "INPUT NUMBER OF MIXES";N
170 Z$ = ""
180  FOR I = 1 TO N
190 X =  INT (6 *  RND (1)):Y =  INT (3 *  RND (1))
200  IF X <  > 0 THEN 220
210 X$ = "R": GOTO 310
220  IF X <  > 1 THEN 240
230 X$ = "F": GOTO 310
```

More

Address correspondence to Curtis and Lillian J. Cooper, 803 E. Clark, Warrensburg, MO 64093.

The program contains two big subroutines. One subroutine is used to rearrange the cube. The following notation, similar to that in James F. Nourse's *The Simple Solution to Rubik's Cube*, is used by the program to change the cube.

Summary of Moves

R+—Turn R face one quarter turn clockwise
R−—Turn R face one quarter turn counterclockwise
R2—Turn R face one half turn
F+—Turn F face one quarter turn clockwise
F−—Turn F face one quarter turn counterclockwise
F2—Turn F face one half turn
L+—Turn L face one quarter turn clockwise
L−—Turn L face one quarter turn counterclockwise
L2—Turn L face one half turn
D+—Turn D face one quarter turn clockwise
D−—Turn D face one quarter turn counterclockwise
D2—Turn D face one half turn
U+—Turn U face one quarter turn clockwise
U−—Turn U face one quarter turn counterclockwise
U2—Turn U face one half turn
B+—Turn B face one quarter turn clockwise
B−—Turn B face one quarter turn counterclockwise
B2—Turn B face one half turn
MFR# where # is 1, 2, or 3—Rotate the cube about the axis passing through the center squares of the up (top) and down (bottom) faces. Move F to R face 1, 2, or 3 times.
MFU# where # is 1, 2, or 3—Rotate the cube about the axis passing through the center squares of the right and left faces. Move F to U face 1, 2, or 3 times.
MUR# where # is 1, 2, or 3—Rotate the cube about the axis passing through the center squares of the front and back faces. Move U to R face 1, 2, or 3 times.

Several moves can be performed on the cube by concatenating together any of the above moves.

The second subroutine draws the cube. Two views are displayed on the screen. The first view shows the corner formed by the up, right and front faces as the corner closest to the viewer. The second view has the opposite corner (formed by the down, left and back faces) closest to the viewer. The faces are each labeled (see photo).

The program begins by initializing the cube and asking how many moves you want it to make to mix up the cube. It is then randomly mixed the number of times specified and the resulting cube is displayed. The program asks you to input your move or moves. Invalid move entries are rejected and you are asked to reenter your move. If S is input, the program stops. Otherwise the resulting cube is displayed and another move is requested.

Enjoy exploring this color-graphics version of Rubik's Cube.■

References

Nourse, James G. *The Simple Solution to Rubik's Cube* (New York: Bantom Books, 1981).

Singmaster, David. *Notes on Rubik's 'Magic Cube'* (Hillside, New Jersey: Enslow Publishers, 1980).

Listing continued.

```
240  IF X <  > 2 THEN 260
250 X$ = "L":: GOTO 310
260  IF X <  > 3 THEN 280
270 X$ = "U": GOTO 310
280  IF X <  > 4 THEN 300
290 X$ = "B": GOTO 310
300 X$ = "D"
310  IF Y <  > 0 THEN 330
320 Y$ = "+": GOTO 360
330  IF Y <  > 1 THEN 350
340 Y$ = "-": GOTO 360
350 Y$ = "2"
360 Z$ = Z$ + X$ + Y$
370  NEXT I
380  GOSUB 500
390  GOSUB 2050
400  REM
410  REM CHANGE RUBIK'S CUBE
420  REM
430  INPUT "INPUT MOVE ";Z$
440  GOSUB 500
450  GOSUB 2050
460  GOTO 430
470  REM
480  REM PERFORM MOVES
490  REM
500  FOR I = 1 TO 5: FOR J = 1 TO 5: FOR K = 1 TO 5
510 R1(I,J,K) = R(I,J,K)
520  NEXT K: NEXT J: NEXT I
530  IF Z$ = "" THEN  RETURN
540 X$ =  MID$ (Z$,1,1)
550  IF X$ = "S" THEN 3100
560  IF X$ = "M" THEN 1250
570  REM
580  REM  MOVE FACES
590  REM
600 Y$ =  MID$ (Z$,2,1)
610  IF X$ <  > "R" THEN 710
620  FOR I = 1 TO 5: FOR J = 1 TO 5
630 A(I,J) = R(I,1,J):B(I,J) = R(I,2,J)
640  NEXT J: NEXT I
650  GOSUB 1720
660  IF E = 1 THEN 1670
670  FOR I = 1 TO 5: FOR J = 1 TO 5
680 R(I,1,J) = A(I,J):R(I,2,J) = B(I,J)
690  NEXT J: NEXT I
700  GOTO 1200
710  IF X$ <  > "F" THEN 810
720  FOR I = 1 TO 5: FOR J = 1 TO 5
730 A(I,J) = R(1,I,J):B(I,J) = R(2,I,J)
740  NEXT J: NEXT I
750  GOSUB 1800
760  IF E = 1 THEN 1670
770  FOR I = 1 TO 5: FOR J = 1 TO 5
780 R(1,I,J) = A(I,J):R(2,I,J) = B(I,J)
790  NEXT J: NEXT I
800  GOTO 1200
810  IF X$ <  > "L" THEN 910
820  FOR I = 1 TO 5: FOR J = 1 TO 5
830 A(I,J) = R(I,5,J):B(I,J) = R(I,4,J)
840  NEXT J: NEXT I
850  GOSUB 1800
860  IF E = 1 THEN 1670
870  FOR I = 1 TO 5: FOR J = 1 TO 5
880 R(I,5,J) = A(I,J):R(I,4,J) = B(I,J)
890  NEXT J: NEXT I
900  GOTO 1200
910  IF X$ <  > "B" THEN 1010
920  FOR I = 1 TO 5: FOR J = 1 TO 5
930 A(I,J) = R(5,I,J):B(I,J) = R(4,I,J)
940  NEXT J: NEXT I
950  GOSUB 1720
960  IF E = 1 THEN 1670
970  FOR I = 1 TO 5: FOR J = 1 TO 5
980 R(5,I,J) = A(I,J):R(4,I,J) = B(I,J)
990  NEXT J: NEXT I
1000  GOTO 1200
1010  IF X$ <  > "U" THEN 1110
1020  FOR I = 1 TO 5: FOR J = 1 TO 5
1030 A(I,J) = R(I,J,5):B(I,J) = R(I,J,4)
1040  NEXT J: NEXT I
1050  GOSUB 1720
1060  IF E = 1 THEN 1670
1070  FOR I = 1 TO 5: FOR J = 1 TO 5
```

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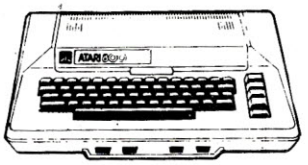

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Listing continued.

```
1080 R(I,J,5) = A(I,J):R(I,J,4) = B(I,J)
1090  NEXT J: NEXT I
1100  GOTO 1200
1110  IF X$ <  > "D" THEN 1670
1120  FOR I = 1 TO 5: FOR J = 1 TO 5
1130 A(I,J) = R(I,J,1):B(I,J) = R(I,J,2)
1140  NEXT J: NEXT I
1150  GOSUB 1800
1160  IF E = 1 THEN 1670
1170  FOR I = 1 TO 5: FOR J = 1 TO 5
1180 R(I,J,1) = A(I,J):R(I,J,2) = B(I,J)
1190  NEXT J: NEXT I
1200 Z$ =  MID$ (Z$,3)
1210  GOTO 530
1220  REM
1230  REM  CHANGE VIEWING CORNERS
1240  REM
1250 X$ =  MID$ (Z$,2,1):Y$ =  MID$ (Z$,3,1)
1260 S$ =  MID$ (Z$,4,1)
1270  IF S$ <  > "1" AND S$ <  > "2" AND S$ <  > "3" THEN 1670
1280 N =  VAL (S$)
1290  IF X$ <  > "F" THEN 1540
1300  IF Y$ <  > "R" THEN 1420
1310 Z$ =  MID$ (Z$,5)
1320  FOR K = 1 TO N
1330 Z$ = "U-D+" + Z$
1340  FOR I = 1 TO 5: FOR J = 1 TO 5
1350 A(I,J) = R(I,J,,3)
1360  NEXT J: NEXT I
1370  FOR I = 1 TO 5: FOR J = 1 TO 5
1380 R(6 - J,I,3) = A(I,J)
1390  NEXT J: NEXT I
1400  NEXT K
1410  GOTO 530
1420  IF Y$ <  > "U" THEN 1670
1430 Z$ =  MID$ (Z$,5)
1440  FOR K = 1 TO N
1450 Z$ = "R+L-" + Z$
1460  FOR I = 1 TO 5: FOR J = 1 TO 5
1470 A(I,J) = R(I,3,J)
1480  NEXT J: NEXT I
1490  FOR I = 1 TO 5: FOR J = 1 TO 5
1500 R(J,3,6 - I) = A(I,J)
1510  NEXT J: NEXT I
1520  NEXT K
1530  GOTO 530
1540  IF X$ <  > "U" THEN 1670
1550  IF Y$ <  > "R" THEN 1670
1560 Z$ =  MID$ (Z$,5)
1570  FOR K = 1 TO N
1580 Z$ = "F+B-" + Z$
1590  FOR I = 1 TO 5: FOR J = 1 TO 5
1600 A(I,J) = R(3,I,J)
1610  NEXT J: NEXT I
1620  FOR I = 1 TO 5: FOR J = 1 TO 5
1630 R(3,6 - J,I) = A(I,J)
1640  NEXT J: NEXT I
1650  NEXT K
1660  GOTO 530
1670  PRINT "INVALID MOVE, TRY AGAIN."
1680  FOR I = 1 TO 5: FOR J = 1 TO 5: FOR K = 1 TO 5
1690 R(I,J,K) = R1(I,J,K)
1700  NEXT K: NEXT J: NEXT I
1710  RETURN
1720 E = 0
1730  IF Y$ <  > "+" THEN 1750
1740  GOSUB 1950: RETURN
1750  IF Y$ <  > "-" THEN 1770
1760  GOSUB 1880: RETURN
1770  IF Y$ <  > "2" THEN 1790
1780  GOSUB 1880: GOSUB 1880: RETURN
1790 E = 1: RETURN
1800 E = 0
1810  IF Y$ <  > "+" THEN 1830
1820  GOSUB 1880: RETURN
1830  IF Y$ <  > "-" THEN 1850
1840  GOSUB 1950: RETURN
1850  IF Y$ <  > "2" THEN 1870
1860  GOSUB 1880: GOSUB 1880: RETURN
1870 E = 1: RETURN
1880  FOR I = 1 TO 5: FOR J = 1 TO 5
1890 C(I,J) = A(I,J):D(I,J) = B(I,J)
1900  NEXT J: NEXT I
1910  FOR I = 1 TO 5: FOR J = 1 TO 5
1920 A(6 - J,I) = C(I,J):B(6 - J,I) = D(I,J)
1930  NEXT J: NEXT I
1940  RETURN
1950  FOR I = 1 TO 5: FOR J = 1 TO 5
1960 C(I,J) = A(I,J):D(I,J) = B(I,J)
1970  NEXT J: NEXT I
1980  FOR I = 1 TO 5: FOR J = 1 TO 5
1990 A(J,6 - I) = C(I,J):B(J,6 - I) = D(I,J)
2000  NEXT J: NEXT I
2010  RETURN
2020  REM
2030  REM  PRINT RUBIK'S CUBE
2040  REM
2050  TEXT
2060  GR
2070  COLOR= 0
2080 X1 = 9:Y1 = 39:X2 = 6:Y2 = 36:X3 = 3:Y3 = 33:X4 = 0:Y4 = 30:W2 = 12:W3 = 15
:W4 = 18
2090  FOR I = 0 TO 15
2100  PLOT X1,Y1 - I: PLOT X2,Y2 - I: PLOT X3,Y3 - I: PLOT X4,Y4 - I: PLOT W2,Y2
 - I: PLOT W3,Y3 - I: PLOT W4,Y4 - I
2110  NEXT I
```

More →

```
2120 X1 = 9:Z1 = 39:Z2 = 34:Z3 = 29:Z4 = 24:Y2 = 21:Y3 = 18:Y4 = 15
2130  FOR I = 0 TO 9
2140  PLOT X1 + I,Z1 - I: PLOT X1 + I,Z2 - I: PLOT X1 + I,Z3 - I: PLOT X1 + I,Z4
 - I
2150  PLOT X1 - I,Z1 - I: PLOT X1 - I,Z2 - I: PLOT X1 - I,Z3 - I: PLOT X1 - I,Z4
 - I
2160  PLOT X2 + I,Y2 - I: PLOT X3 + I,Y3 - I: PLOT X4 + I,Y4 - I
2170  PLOT W2 - I,Y2 - I: PLOT W3 - I,Y3 - I: PLOT W4 - I,Y4 - I
2180  NEXT I
2190 X1 = 30:X2 = 27:X3 = 24:X4 = 21:Y1 = 21:Y2 = 24:Y3 = 27:Y4 = 30:W2 = 33:W3
= 36:W4 = 39
2200  FOR I = 0 TO 15
2210  PLOT X1,Y1 - I: PLOT X2,Y2 - I: PLOT X3,Y3 - I: PLOT X4,Y4 - I: PLOT W2,Y2
 - I: PLOT W3,Y3 - I: PLOT W4,Y4 - I
2220  NEXT I
2230 X1 = 30:Z1 = 6:Z2 = 11:Z3 = 16:Z4 = 21
2240  FOR I = 0 TO 9
2250  PLOT X1 - I,Z1 + I: PLOT X1 - I,Z2 + I: PLOT X1 - I,Z3 + I: PLOT X1 - I,Z4
 + I
2260  PLOT X1 + I,Z1 + I: PLOT X1 + I,Z2 + I: PLOT X1 + I,Z3 + I: PLOT X1 + I,Z4
 + I
2270  PLOT X2 + I,Y2 + I: PLOT X3 + I,Y3 + I: PLOT X4 + I,Y4 + I
2280  PLOT W2 - I,Y2 + I: PLOT W3 - I,Y3 + I: PLOT W4 - I,Y4 + I
2290  NEXT I
2300  PRINT "    UP(TOP)              BACK           LEFT"
2310  PRINT "  FRONT    RIGHT                DOWN(BOTTOM)"
2320 X1 = 8:X2 = 7:Y1 = 37:Y2 = 36
2330  FOR J = 2 TO 4: FOR K = 2 TO 4
2340 I = 1
2350  GOSUB 2990
2360  FOR I = 0 TO 3
2370  PLOT X1 - 3 * (J - 2),Y1 - I - 5 * (K - 2) - 3 * (J - 2)
2380  PLOT X2 - 3 * (J - 2),Y2 - I - 5 * (K - 2) - 3 * (J - 2)
2390  NEXT I
2400  NEXT K: NEXT J
2410 X1 = 10:X2 = 11:Y1 = 37:Y2 = 36
2420  FOR I = 2 TO 4: FOR K = 2 TO 4
2430 J = 1
2440  GOSUB 2990
2450  FOR J = 0 TO 3
2460  PLOT X1 + 3 * (I - 2),Y1 - J - 5 * (K - 2) - 3 * (I - 2)
2470  PLOT X2 + 3 * (I - 2),Y2 - J - 5 * (K - 2) - 3 * (I - 2)
2480  NEXT J
2490  NEXT K: NEXT I
2500 X1 = 32:X2 = 31:Y1 = 22:Y2 = 21
2510  FOR I = 4 TO 2 STEP  - 1: FOR K = 2 TO 4
2520 J = 5
2530  GOSUB 2990
2540  FOR J = 0 TO 3
2550  PLOT X1 + 3 * (4 - I),Y1 - J - 5 * (K - 2) + 3 * (4 - I)
2560  PLOT X2 + 3 * (4 - I),Y2 - J - 5 * (K - 2) + 3 * (4 - I)
2570  NEXT J
2580  NEXT K: NEXT I
2590 X1 = 28:X2 = 29:Y1 = 22:Y2 = 21
2600  FOR J = 4 TO 2 STEP  - 1: FOR K = 2 TO 4
2610 I = 5
2620  GOSUB 2990
2630  FOR I = 0 TO 3
2640  PLOT X1 - 3 * (4 - J),Y1 - I - 5 * (K - 2) + 3 * (4 - J)
2650  PLOT X2 - 3 * (4 - J),Y2 - I - 5 * (K - 2) + 3 * (4 - J)
2660  NEXT I
2670  NEXT K: NEXT J
2680 X1 = 7:X2 = 8:X3 = 9:X4 = 10:X5 = 11
2690 Y1 = 21:Y2 = 22:Y3 = 23:Y4 = 22:Y5 = 21
2700  FOR I = 2 TO 4: FOR J = 2 TO 4
2710 K = 5
2720  GOSUB 2990
2730  PLOT X1 + 3 * (I - 2) - 3 * (J - 2),Y1 - 3 * (J - 2) - 3 * (I - 2)
2740  PLOT X5 + 3 * (I - 2) - 3 * (J - 2),Y5 - 3 * (J - 2) - 3 * (I - 2)
2750  FOR K = 0 TO 2
2760  PLOT X2 + 3 * (I - 2) - 3 * (J - 2),Y2 - K - 3 * (J - 2) - 3 * (I - 2)
2770  PLOT X4 + 3 * (I - 2) - 3 * (J - 2),Y4 - K - 3 * (J - 2) - 3 * (I - 2)
2780  NEXT K
2790  FOR K = 0 TO 4
2800  PLOT X3 + 3 * (I - 2) - 3 * (J - 2),Y3 - K - 3 * (J - 2) - 3 * (I - 2)
2810  NEXT K
2820  NEXT J: NEXT I
2830 X1 = 28:X2 = 29:X3 = 30:X4 = 31:X5 = 32
2840 Y1 = 24:Y2 = 23:Y3 = 22:Y4 = 23:Y5 = 24
2850  FOR I = 4 TO 2 STEP  - 1: FOR J = 4 TO 2 STEP  - 1
2860 K = 1
2870  GOSUB 2990
2880  PLOT X1 + 3 * (4 - I) - 3 * (4 - J),Y1 + 3 * (4 - J) + 3 * (4 - I)
2890  PLOT X5 + 3 * (4 - I) - 3 * (4 - J),Y5 + 3 * (4 - J) + 3 * (4 - I)
2900  FOR K = 0 TO 2
2910  PLOT X2 + 3 * (4 - I) - 3 * (4 - J),Y2 + K + 3 * (4 - J) + 3 * (4 - I)
2920  PLOT X4 + 3 * (4 - I) - 3 * (4 - J),Y4 + K + 3 * (4 - J) + 3 * (4 - I)
2930  NEXT K
2940  FOR K = 0 TO 4
2950  PLOT X3 + 3 * (4 - I) - 3 * (4 - J),Y3 + K + 3 * (4 - J) + 3 * (4 - I)
2960  NEXT K
2970  NEXT J: NEXT I
2980  RETURN
2990  IF R(I,J,K) <  > 1 THEN 3010
3000  COLOR= 1: RETURN
3010  IF R(I,J,K) <  > 15 THEN 3030
3020  COLOR= 15: RETURN
3030  IF R(I,J,K) <  > 4 THEN 3050
3040  COLOR= 4: RETURN
3050  IF R(I,J,K) <  > 9 THEN 3070
3060  COLOR= 9: RETURN
3070  IF R(I,J,K) <  > 2 THEN 3090
3080  COLOR= 2: RETURN
3090  COLOR= 13: RETURN
3100  PRINT "THANK YOU FOR PLAYING."
3110  END
```


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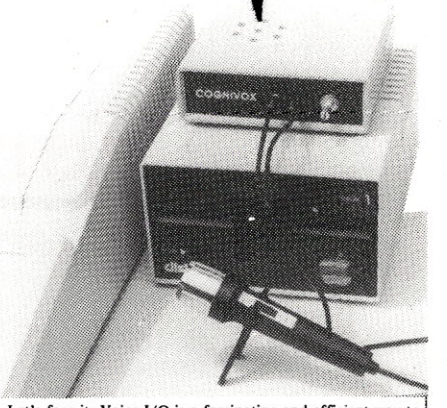

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And for you Z-80 puzzle buffs, here's a program to simulate Rubik's Cube and thus reduce the risk of thumb-joint injury.

First Aid For Cuber's Thumb

By Paul A. Turvill

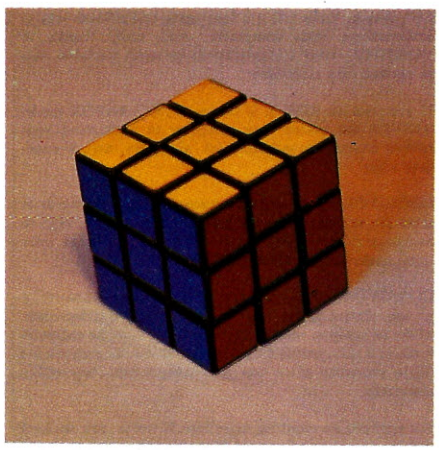

Photo 1. The pristine *Rubik's Cube.*

Rubik's Cube—also known as the Magic Cube, and a number of less complimentary names by numerous harried puzzle fans—is the current intellectual puzzle rage. The puzzle is especially intriguing to mathematics, engineering and science buffs, for a number of reasons. Mechanically, it does things that at first glance would seem impossible, even to many experienced mechanical engineers. Mathematically, it is fascinating, having the ability to be arranged and rearranged into $2^{27} \times 3^{14} \times 5^3 \times 7^2 \times 11$ configurations —more than 4.3×10^{19} permutations!

Address correspondence to Paul A. Turvill, 4733 Bel Roma Road, Livermore, CA 94550.

Cube solvers around the world—known as *cubists*—have become so enthralled with Rubik's Cube that it now occupies much of the spare time of literally millions of Earth's citizens. So popular and so intriguing is it that it has received attention on page one of *The Wall Street Journal* and the front cover of *Scientific American*.

Douglas Hofstadter's *Scientific American* article (March 1981, p. 20) is probably one of the best summaries of the cube's possibilities yet published. Hofstadter goes into mechanical construction, mathematical considerations and various approaches to developing solution algorithms. He also discusses in some detail a standard system of notation designed to permit cubists to readily exchange information about their solution efforts.

While Hofstadter's article is highly recommended, the following description should give a basic understanding of the device and point out the usefulness of the listed computer programs. Notation and terminology are based on those introduced by Hofstadter.

A Cube in the Hand

Rubik's Cube rests nicely on the palm of the hand. Each of its six faces is subdivided into nine equal *facelets*. In the starting position, or *pristine state*, each of the cube's major faces is a different uniform color (see Photo 1).

The cube is cut between facelets—in fact, it consists of 26 visible *cubies* (the centermost space is assumed to be unoccupied). Further, the 26 cubies are interlocked so that the nine cubies that make up each of the six major faces may be rotated as a group (see Photo 2).

By rotating any one face, you can partially rearrange the four adjacent faces. Thus, a series of 90-degree rotations of the various faces can quickly *scramble* the arrangement of the colored facelets.

Most cubists have had great difficulty establishing even a few common predetermined patterns, not to mention returning their cubes to the pristine state. A number of algorithms have been developed with varying degrees of success.

The Programs

These computer programs—one in BASIC (Listing 1), and one in Z-80 assembly language (Listing 2)—are intended to help you make sequences of moves to take the cube from one state to another. The programs oper-

	Rotation	
Face	**CW**	**CCW**
Up (top)	U	u
Down (bottom)	D	d
Left side	L	l
Right side	R	r
Front	F	f
Back	B	b

Table 1.

ate essentially identically, although it will be seen that the machine-language code generated by the assembly-language program is far more efficient in memory requirements and operating speed. Because of their similarity, the following discussion applies equally to both.

The notation used (based on the Hofstadter article) is as follows: the major faces are identified in accordance with their positions on a cube held stationary in relation to the viewer—Up, Down, Left, Right, Front and Back (see Fig. 1).

For simplicity and ease of presentation on a two-dimensional alphanumeric display device (and printer), the cube is *unfolded* so that its six faces can be seen simultaneously (see Fig. 2).

Once the program is loaded and running properly, the legend Move Sequence: will appear at the top of the screen, with a representation of the unfolded cube laid out below, in its pristine state (see Sample run in Fig. 3). Thereafter, keying any of the 12 legal move commands will cause the appropriate face to be rotated by 90 degrees, and the four adjacent faces to be rearranged accordingly. The Move Sequence will be updated and the display modified to reflect the cumulative effect of all move commands.

Table 1 summarizes the 12 permissible move commands and their effects; in the table, CW indicates clockwise, or "right" rotation, and CCW means counterclockwise, or "left." The notation differs somewhat from that of the Hofstadter article. To retain the simplicity afforded by single character commands, these programs use a combination of uppercase (for CW) and lowercase (CCW) characters.

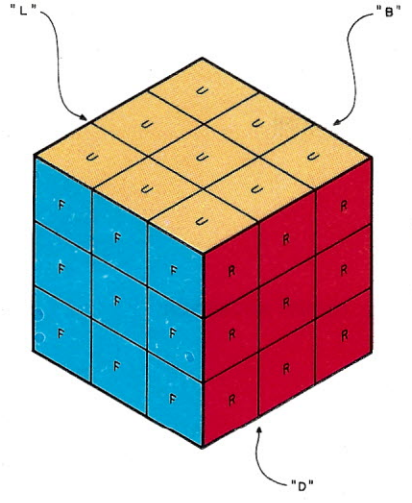

Fig. 1. Face-identification symbols.

In addition to the 12 move commands, three additional commands are available:

- P (Print) produces a hard copy of the current screen.
- N (New) reinitializes the cube to the pristine state or starting position.
- X(eXit) returns control to the system monitor (or the interpreter in the case of BASIC).

Languages

Some comments are in order regarding programming languages and formats. Many differences exist among the various forms of BASIC. Cube is written to run in a modified form of Digital Group Business BASIC 1.0, which contains a number of shortcuts (the option to use # for PRINT, for example), and has its own approach to the handling of string variables. It should not be too difficult for the moderately capable reader to make the necessary conversions to nearly any other form of BASIC having string capabilities. Explanatory REM statements are included in the BASIC program where they may be useful.

Programs written for assembly languages, while usually considered more difficult to write and debug, are generally more universal since the machine-language codes they produce can normally be made to run on just about any machine based on the same or similar microprocessor technology. That is, any assembly program written for one Z-80 machine can generally be made to run on another Z-80 system, provided the I/O port assignments and peripheral driver routines are made compatible.

Further, machine code is usually highly efficient as compared to the

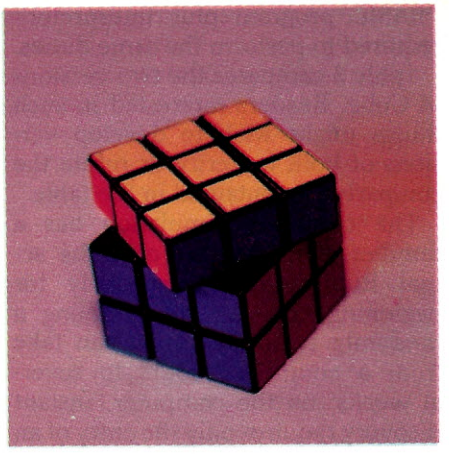

Photo 2. Rubik's Cube with one face partly rotated.

Listing 1. The BASIC listing of the Cube program.

```
1000  REM ****************************************
1010  REM * RUBIK'S CUBE PUZZLE SIMULATOR PROGRAM *
1020  REM * BASIC VERSION 1.00 BY PAUL A. TURVILL *
1030  REM ************** MARCH, 1981 **************
1040  REM ****************************************
1050  REM *
1060  REM * INITIALIZE VARIABLES
1070  REM *
1080  DIM U$(9),D$(9),L$(9),R$(9),F$(9),B$(9)
1090  DIM X$(9),Y$(9),Q$(113),A$(1)
1100  Q$=" " : N=0
1110  FOR I=1 TO 9
1120    U$=U$+"U" : D$=D$+"D"
1130    L$=L$+"L" : R$=R$+"R"
1140    F$=F$+"F" : B$=B$+"B"
1150    Q$=Q$+Q$
1160    NEXT I
1170  REM *
1180  REM * DISPLAY INITIAL SCREEN - NOTE THAT THE SYMBOL "#"
1190  REM * IS USED THROUGHOUT THIS PROGRAM TO REPRESENT THE
1200  REM * "PRINT" STATEMENT.
1210  REM *
1220  GOSUB 1500
1230  REM *
1240  REM * OUTPUT CURSOR CHARACTER
1250  REM *
1260  #CHR$(8);CHR$(95);CHR$(8);
1270  REM *
1280  REM * GET COMMAND AND DECODE IT
1290  REM *
1300  KEYIN A$ : #A$;
1310  IF A$="U" THEN GOSUB 2030
1320  IF A$="u" THEN GOSUB 2110
1330  IF A$="D" THEN GOSUB 2190
1340  IF A$="d" THEN GOSUB 2260
1350  IF A$="L" THEN GOSUB 2330
1360  IF A$="l" THEN GOSUB 2440
1370  IF A$="R" THEN GOSUB 2550
```

More

"BASIC program plus interpreter" required to perform the same duties.

Table 2 compares the two versions of Cube. Readers interested in such things might wish to develop versions of both to verify or refute the comparisons contained in the table.

The computer simulation has a number of advantages over the actual Rubik's Cube, especially for beginning cubists. Unscrambling a randomly scrambled cube can take from a couple of hours to several weeks; on the computer, instant recovery requires only the entry of an N command.

Moving from one structured pattern to another often requires surprisingly few moves, although discovering the exact combination of moves required may involve a great many trial-and-error iterations and numerous dead ends. Once a desired configuration is achieved on the video terminal, entering a P command will print not only the current configuration, but a record of up to the last 113 moves. (In the event the computer-wielding cubist makes 113 moves without achieving a desired result, the computer takes over and

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Listing 1 continued.

```
1380  IF A$="r" THEN GOSUB 2660
1390  IF A$="F" THEN GOSUB 2770
1400  IF A$="f" THEN GOSUB 2870
1410  IF A$="B" THEN GOSUB 2970
1420  IF A$="b" THEN GOSUB 3070
1430  IF A$="N" THEN #""; : RUN
1440  IF A$="X" THEN #""; : END
1450  IF A$="P" THEN GOSUB 3340
1460  GOTO 1260
1470  REM *
1480  REM * SCREEN/PRINTER FORMATTING ROUTINE
1490  REM *
1500  CURSOR 0 : #"Move Sequence: ";Q$;
1510  IF A$="p" THEN #""
1520  FOR I=1 TO 9
1530    IF (I=1 OR I=4 OR I=7) THEN #"" : #TAB(23);
1540    #U$(I,I);"  ";
1550    NEXT I
1560  #"" : #""
1570  FOR I=0 TO 2
1580    #TAB(12);
1590    FOR J=1 TO 3 : K=3*I+J
1600      #L$(K,K);"  ";
1610      NEXT J
1620    #"  ";
1630    FOR J=1 TO 3 : K=3*I+J
1640      #F$(K,K);"  ";
1650      NEXT J
1660    #"  ";
1670    FOR J=1 TO 3 : K=3*I+J
1680      #R$(K,K);"  ";
1690      NEXT J
1700    #"  ";
1710    FOR J=1 TO 3 : K=3*I+J
1720      #B$(K,K);"  ";
1730      NEXT J
1740    #"" : NEXT I
1750  FOR I=1 TO 9
1760    IF (I=1 OR I=4 OR I=7) THEN #"" : #TAB(23);
1770    #D$(I,I);"  ";
1780    NEXT I
1790  #"" : #"" : #"Next Move:  ";
1800  IF N=113 THEN N=0 : A$="P"
1810  RETURN
1820  REM *
1830  REM * STRING HANDLING ROUTINES - EACH FACE OF CUBE IS
1840  REM * REPRESENTED BY A STRING VARIABLE, NINE CHARACTERS
1850  REM * IN LENGTH.  TOP ROW OF FACE AS DISPLAYED ON SCREEN
1860  REM * IS REPRESENTED BY POSITIONS 1, 2, AND 3; MIDDLE
1870  REM * ROW BY 4, 5, AND 6; AND BOTTOM ROW BY 7, 8, AND 9.
1880  REM * PARTIAL STRINGS ARE DEPICTED BY THE VARIABLE NAME
1890  REM * FOLLOWED BY THE STARTING AND ENDING POSITIONS IN
1900  REM * PARENTHESES [EXAMPLE: BOTTOM ROW, FRONT FACE IS
1910  REM * F$(7,9)].  IF ONLY ONE POSITION IS GIVEN IN PAREN-
1920  REM * THESES, IT IS ASSUMED THAT ALL CHARACTERS FROM
1930  REM * NUMBERED POSITION TO THE END ARE INTENDED [EXAMPLE:
1940  REM * U$(4) IS EQUIVALENT TO U$(4,9)].  IN ANY STRING
1950  REM * TRANSACTION THE NUMBER OF CHARACTERS ALTERED IS
1960  REM * GOVERNED BY THE SHORTER SUBSTRING [EXAMPLE: THE
1970  REM * STATEMENT "F$(1)=L$(1,3)" WILL CAUSE THE FIRST
1980  REM * THREE CHARACTERS OF F$ TO BE SET TO THE FIRST THREE
1990  REM * CHARACTERS OF L$].
2000  REM *
2010  REM * UP FACE, CLOCKWISE (CW) ROTATION
2020  REM *
2030  X$=U$ : GOSUB 3140 : U$=Y$
2040  X$=L$
2050  L$(1)=F$(1,3) : F$(1)=R$(1,3)
2060  R$(1)=B$(1,3) : B$(1)=X$(1,3)
2070  GOTO 1500
2080  REM *
2090  REM * UP FACE, COUNTERCLOCKWISE (CCW) ROTATION
2100  REM *
2110  X$=U$ : GOSUB 3190 : U$=Y$
2120  X$=L$
2130  L$(1)=B$(1,3) : B$(1)=R$(1,3)
2140  R$(1)=F$(1,3) : F$(1)=X$(1,3)
2150  GOTO 1500
2160  REM *
2170  REM * DOWN FACE, CW
2180  REM *
2190  X$=D$ : GOSUB 3140 : D$=Y$
```

More →

automatically prints a hard copy, before starting to overwrite the previous Move Sequence.)

The printed record of moves made can then be manually edited for redundancy (U1 followed immediately by Lu, for example), and the resultant edited sequence quickly verified in another run.

Working with both computer and cube, the cubist can systematically apply real moves to the cube after perfecting each sequence painlessly on the machine.

A couple of fairly simple sequences exist that clearly illustrate the cube's possibilities. First try UdR1FbUd; then uuddllrrffbb (or UUDDLLRRFFBB); then combine these and others. Vast numbers of other combinations will suggest themselves, but exercise

(continued on page 46)

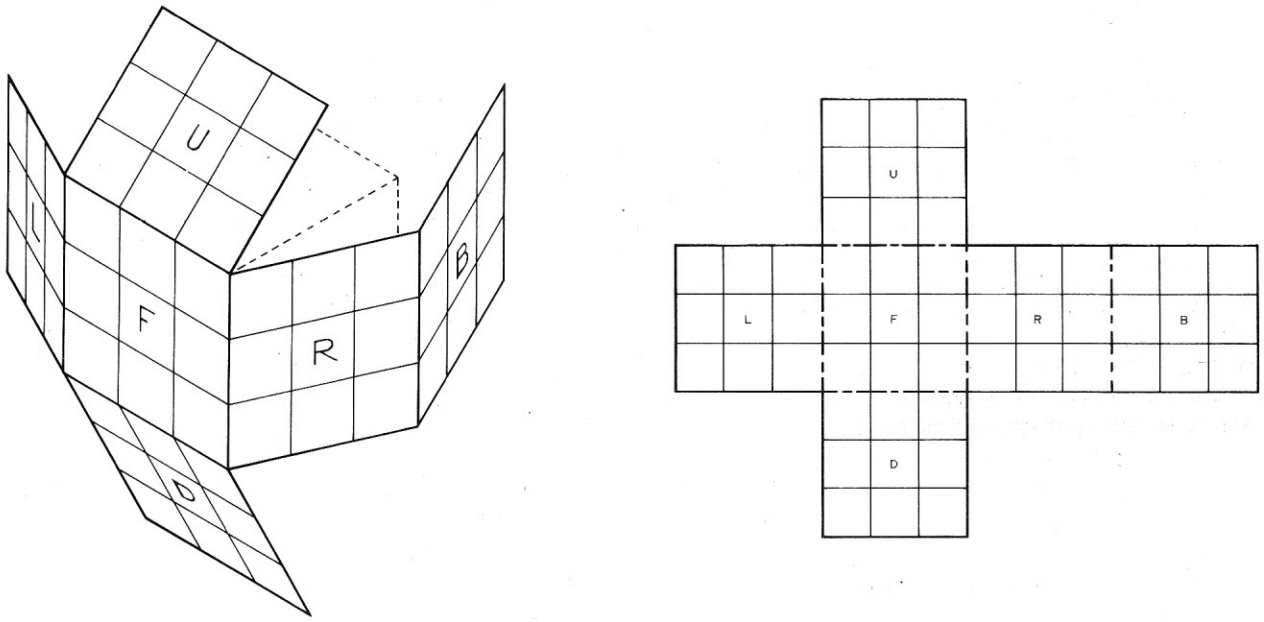

Fig. 2. Unfolding the cube for the video display.

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Listing 1 continued.

```
2200  X$=L$(7)
2210  L$(7)=B$(7) : B$(7)=R$(7) : R$(7)=F$(7) : F$(7)=X$
2220  GOTO 1500
2230  REM *
2240  REM * DOWN FACE, CCW
2250  REM *
2260  X$=D$ : GOSUB 3190 : D$=Y$
2270  X$=L$(7)
2280  L$(7)=F$(7) : F$(7)=R$(7) : R$(7)=B$(7) : B$(7)=X$
2290  GOTO 1500
2300  REM *
2310  REM * LEFT FACE, CW
2320  REM *
2330  X$=L$ : GOSUB 3140 : L$=Y$
2340  X$=U$
2350  U$(1)=B$(9) : U$(4)=B$(6,6) : U$(7)=B$(3,3)
2360  B$(3)=D$(7,7) : B$(6)=D$(4,4) : B$(9)=D$(1)
2370  FOR I=1 TO 7 STEP 3
2380    D$(I)=F$(I,I) : F$(I)=X$(I,I)
2390    NEXT I
2400  GOTO 1500
2410  REM *
```

More →

```
Move Sequence:

                    U  U  U
                    U  U  U
                    U  U  U

          L  L  L   F  F  F   R  R  R   B  B  B
          L  L  L   F  F  F   R  R  R   B  B  B
          L  L  L   F  F  F   R  R  R   B  B  B

                    D  D  D
                    D  D  D
                    D  D  D

Next Move:

Move Sequence: UdRlFbUd

                    F  F  F
                    F  U  F
                    F  F  F

          D  D  D   R  R  R   U  U  U   L  L  L
          D  L  D   R  F  R   U  R  U   L  B  L
          D  D  D   R  R  R   U  U  U   L  L  L

                    B  B  B
                    B  D  B
                    B  B  B

Next Move:

Move Sequence: UdRlFbUduuddllrrffbb

                    F  B  F
                    B  U  B
                    F  B  F

          D  U  D   R  L  R   U  D  U   L  R  L
          U  L  U   L  F  L   D  R  D   R  B  R
          D  U  D   R  L  R   U  D  U   L  R  L

                    B  F  B
                    F  D  F
                    B  F  B

Next Move:
```

Fig. 3. The cube, as it appears on the video display, in its original state and as it appears after two Move Sequences.

Listing 1 continued.

```
2420  REM * LEFT FACE, CCW
2430  REM *
2440  X$=L$ : GOSUB 3190 : L$=Y$
2450  X$=U$
2460  FOR I=1 TO 7 STEP 3
2470    U$(I)=F$(I,I) : F$(I)=D$(I,I)
2480    NEXT I
2490  D$(1)=B$(9) : D$(4)=B$(6,6) : D$(7)=B$(3,3)
2500  B$(3)=X$(7,7) : B$(6)=X$(4,4) : B$(9)=X$(1)
2510  GOTO 1500
2520  REM *
2530  REM * RIGHT FACE, CW
2540  REM *
2550  X$=R$ : GOSUB 3140 : R$=Y$
2560  X$=U$
2570  FOR I=3 TO 9 STEP 3
2580    U$(I)=F$(I,I) : F$(I)=D$(I,I)
2590    NEXT I
2600  D$(3)=B$(7,7) : D$(6)=B$(4,4) : D$(9)=B$(1)
2610  B$(1)=X$(9) : B$(4)=X$(6,6) : B$(7)=X$(3,3)
2620  GOTO 1500
2630  REM *
2640  REM * RIGHT FACE, CCW
2650  REM *
2660  X$=R$ : GOSUB 3190 : R$=Y$
2670  X$=U$
2680  U$(3)=B$(7,7) : U$(6)=B$(4,4) : U$(9)=B$(1)
2690  B$(1)=D$(9) : B$(4)=D$(6,6) : B$(7)=D$(3,3)
2700  FOR I=3 TO 9 STEP 3
2710    D$(I)=F$(I,I) : F$(I)=X$(I,I)
2720    NEXT I
2730  GOTO 1500
2740  REM *
2750  REM * FRONT FACE, CW
2760  REM *
2770  X$=F$ : GOSUB 3140 : F$=Y$
2780  X$=U$
2790  U$(7)=L$(9) : U$(8)=L$(6) : U$(9)=L$(3)
2800  L$(3)=D$(1,1) : L$(6)=D$(2,2) : L$(9)=D$(3)
2810  D$(1)=R$(7) : D$(2)=R$(4,4) : D$(3)=R$(1,1)
2820  R$(1)=X$(7,7) : R$(4)=X$(8,8) : R$(7)=X$(9)
2830  GOTO 1500
2840  REM *
2850  REM * FRONT FACE, CCW
2860  REM *
2870  X$=F$ : GOSUB 3190 : F$=Y$
2880  X$=U$
2890  U$(7)=R$(1) : U$(8)=R$(4) : U$(9)=R$(7)
2900  R$(1)=D$(3,3) : R$(4)=D$(2,2) : R$(7)=D$(1,1)
2910  D$(1)=L$(3,3) : D$(2)=L$(6,6) : D$(3)=L$(9)
2920  L$(3)=X$(9) : L$(6)=X$(8,8) : L$(9)=X$(7)
2930  GOTO 1500
2940  REM *
2950  REM * BACK FACE, CW
2960  REM *
2970  X$=B$ : GOSUB 3140 : B$=Y$
2980  X$=U$
2990  U$(1)=R$(3,3) : U$(2)=R$(6,6) : U$(3)=R$(9)
3000  R$(3)=D$(9) : R$(6)=D$(8,8) : R$(9)=D$(7)
3010  D$(7)=L$(1) : D$(8)=L$(4) : D$(9)=L$(7)
3020  L$(1)=X$(3,3) : L$(4)=X$(2,2) : L$(7)=X$(3,3)
3030  GOTO 1500
3040  REM *
3050  REM * BACK FACE, CCW
3060  REM *
3070  X$=B$ : GOSUB 3190 : B$=Y$
3080  X$=U$
3090  U$(1)=L$(7) : U$(2)=L$(4,4) : U$(3)=L$(1,1)
3100  L$(1)=D$(7,7) : L$(4)=D$(8,8) : L$(7)=D$(9)
3110  D$(7)=R$(9) : D$(8)=R$(6) : D$(9)=R$(3)
3120  R$(3)=X$(1,1) : R$(6)=X$(2,2) : R$(9)=X$(3)
3130  GOTO 1500
3140  GOSUB 3240
3150  Y$(1)=X$(7) : Y$(2)=X$(4,4) : Y$(3)=X$(1,1)
3160  Y$(4)=X$(8,8) : Y$(6)=X$(2)
3170  Y$(7)=X$(9) : Y$(8)=X$(6) : Y$(9)=X$(3)
3180  RETURN
3190  GOSUB 3240
3200  Y$(1)=X$(3,3) : Y$(2)=X$(6,6) : Y$(3)=X$(9)
3210  Y$(4)=X$(2,2) : Y$(6)=X$(8)
3220  Y$(7)=X$(1) : Y$(8)=X$(4) : Y$(9)=X$(7)
3230  RETURN
3240  Y$=X$ : N=N+1 : Q$(N)=A$
```

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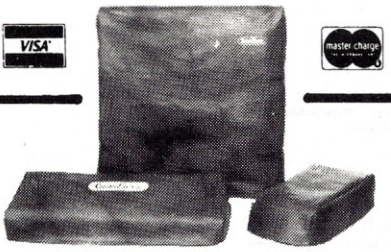

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Listing 1 continued.

```
3250  IF N,113 THEN Q$(N+1)=" "
3260  RETURN
3270  REM *
3280  REM * HARDCOPY ROUTINE - "FILL" STATEMENT IS EQUIVALENT
3290  REM * TO "POKE," AND IS USED HERE TO TEMPORARILY ADJUST
3300  REM * OUTPUT LINE LENGTH TO PREVENT PRINTER FROM OVER-
3310  REM * RUNNING PAPER WIDTH.  "OPEN" AND "CLOSE" STATEMENTS
3320  REM * TURN OUTPUT DEVICES ON AND OFF.
3330  REM *
3340  CLOSE (CRT,E) : OPEN (PRINTER,E)
3350  FILL 12890,64 : A$="p"
3360  #""
3370  GOSUB 1500
3380  FOR I=1 TO 12 : #"" : NEXT I
3390  CLOSE (PRINTER,E) : OPEN (CRT,E)
3400  FILL 12890,132 : A$=" "
3410  GOTO 1500
```

	Bytes of Code	
	BASIC	**Assembly**
Interpreter	17,920	0 (1)
Main Program	5,507	2,224
Variables	329	0 (2)
Printer Driver	0 (3)	768
Total Bytes	23,756	2,992
	Execution Times	
Each Command	2.0 sec.	0.1 sec.
20 Commands (4)	44.0 sec.	5.4 sec.

Notes:
(1) Assembly-language program need not be present while application program is running.
(2) Variable storage locations included in main program.
(3) Printer driver included in BASIC interpreter.
(4) Includes operator reaction times between keystrokes.

Table 2. Comparison of features of the BASIC and assembly versions of the Cube program.

Listing 2. Z-80 assembly-language version of the Cube program.

```
0000                    0100        ST   0
0000                    0110 *
0000                    0120 ****************************************
0000                    0130 * RUBIK'S CUBE PUZZLE SIMULATOR PROGRAM *
0000                    0140 * VERSION 1.00       BY PAUL A. TURVILL *
0000                    0150 ************** MARCH, 1981 **************
0000                    0160 ****************************************
0000                    0170 *
0000 18 15              0180 START  JR   BEGIN
0002 C3 18 01           0190        JP   UPDATE       RESTART VECTORS
0005 C3 88 E3           0200        JP   EDITOR
0008 C3 6A E3           0210        JP   KEYIN
000B C3 70 F3           0220        JP   TRMOUT
000E C3 8A 08           0230        JP   PRINT
0011 C3 B0 EF           0240        JP   LPRTR
0014 C3 00 00           0250        JP   0
0017 31 8A 08           0260 BEGIN  LD   SP,STAK      SET STACK POINTER
001A 11 7F 07           0270        LD   DE,MOVES     INITIALIZE
001D 0E 71              0280        LD   C,113D         MOVE
001F D5                 0290        PUSH DE             SEQUENCE
0020 EB                 0300        EX   DE,HL          RECORD
0021 41                 0310        LD   B,C
0022 36 A0              0320 BEGIN1 LD   M,240
0024 23                 0330        INC  HL
0025 10 FB              0340        DJNZ BEGIN1
0027 D1                 0350        POP  DE
0028 3E D5              0360 INIT   LD   A,'U'        INITIALIZE
002A 32 F2 07           0370        LD   (U1),A         CUBE
002D 32 F4 07           0380        LD   (U2),A         TO
0030 32 F6 07           0390        LD   (U3),A         STARTING
0033 32 F8 07           0400        LD   (U4),A         POSITION
0036 32 FC 07           0410        LD   (U6),A
```

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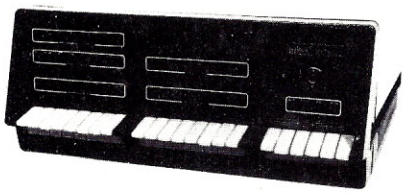

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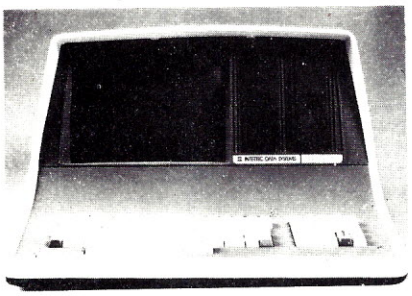

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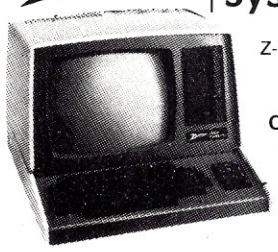

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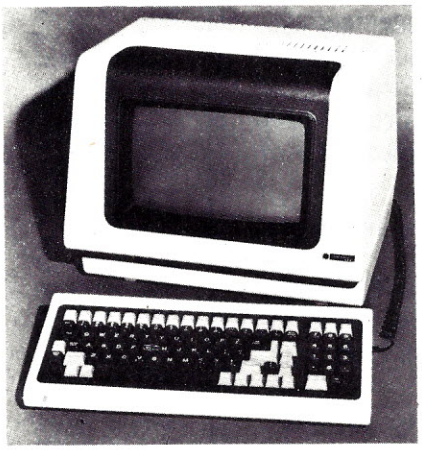

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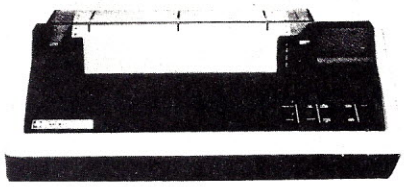

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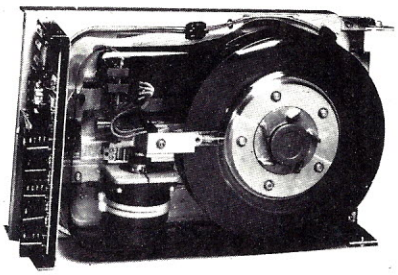

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```
0039 32 FE 07     0420          LD   (U7),A
003C 32 00 08     0430          LD   (U8),A
003F 32 02 08     0440          LD   (U9),A
0042 3E C4        0450          LD   A,'D'
0044 32 4C 08     0460          LD   (D1),A
0047 32 4E 08     0470          LD   (D2),A
004A 32 50 08     0480          LD   (D3),A
004D 32 52 08     0490          LD   (D4),A
0050 32 56 08     0500          LD   (D6),A
0053 32 58 08     0510          LD   (D7),A
0056 32 5A 08     0520          LD   (D8),A
0059 32 5C 08     0530          LD   (D9),A
005C 3E CC        0540          LD   A,'L'
005E 32 04 08     0550          LD   (L1),A
0061 32 06 08     0560          LD   (L2),A
0064 32 08 08     0570          LD   (L3),A
0067 32 1C 08     0580          LD   (L4),A
006A 32 20 08     0590          LD   (L6),A
006D 32 34 08     0600          LD   (L7),A
0070 32 36 08     0610          LD   (L8),A
0073 32 38 08     0620          LD   (L9),A
0076 3E D2        0630          LD   A,'R'
0078 32 10 08     0640          LD   (R1),A
007B 32 12 08     0650          LD   (R2),A
007E 32 14 08     0660          LD   (R3),A
0081 32 28 08     0670          LD   (R4),A
0084 32 2C 08     0680          LD   (R6),A
0087 32 40 08     0690          LD   (R7),A
008A 32 42 08     0700          LD   (R8),A
008D 32 44 08     0710          LD   (R9),A
0090 3E C6        0720          LD   A,'F'
0092 32 0A 08     0730          LD   (F1),A
0095 32 0C 08     0740          LD   (F2),A
0098 32 0E 08     0750          LD   (F3),A
009B 32 22 08     0760          LD   (F4),A
009E 32 26 08     0770          LD   (F6),A
00A1 32 3A 08     0780          LD   (F7),A
00A4 32 3C 08     0790          LD   (F8),A
00A7 32 3E 08     0800          LD   (F9),A
00AA 3E C2        0810          LD   A,'B'
00AC 32 16 08     0820          LD   (B1),A
00AF 32 18 08     0830          LD   (B2),A
00B2 32 1A 08     0840          LD   (B3),A
00B5 32 2E 08     0850          LD   (B4),A
00B8 32 32 08     0860          LD   (B6),A
00BB 32 46 08     0870          LD   (B7),A
00BE 32 48 08     0880          LD   (B8),A
00C1 32 4A 08     0890          LD   (B9),A
00C4              0900 *
00C4              0910 * SCREEN DISPLAY ROUTINE
00C4              0920 *
00C4 21 6F 07     0930 DISPLY LD   HL,SCREEN
00C7 C5           0940          PUSH BC
00C8 D7           0950          RST  20
00C9 C1           0960          POP  BC
00CA              0970 *
00CA              0980 * COMMAND INPUT AND RECOGNITION
00CA              0990 *
00CA DF           1000 GETCMD RST  30
00CB E7           1010          RST  40
00CC FE D5        1020          CP   'U'
00CE 28 57        1030          JR   Z,UPRT
00D0 FE F5        1040          CP   'u'
00D2 CA AD 01     1050          JP   Z,UPLT
00D5 FE C4        1060          CP   'D'
00D7 CA 33 02     1070          JP   Z,DNRT
00DA FE E4        1080          CP   'd'
00DC CA B9 02     1090          JP   Z,DNLT
00DF FE CC        1100          CP   'L'
00E1 CA 3F 03     1110          JP   Z,LTRT
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00E6 CA C5 03     1130          JP   Z,LTLT
00E9 FE D2        1140          CP   'R'
00EB CA 4B 04     1150          JP   Z,RTRT
00EE FE F2        1160          CP   'r'
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00F8 FE E6        1200          CP   'f'
00FA CA DD 05     1210          JP   Z,FRLT
00FD FE C2        1220          CP   'B'
00FF CA 63 06     1230          JP   Z,BKRT
0102 FE E2        1240          CP   'b'
0104 CA E9 06     1250          JP   Z,BKLT
```

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Listing 2 continued.

```
0107 FE CE        1260        CP   'N'
0109 CA 17 00     1270        JP   Z,BEGIN
010C FE D8        1280        CP   'X'
010E CA 00 E0     1290        JP   Z,MONITR
0111 FE D0        1300        CP   'P'
0113 CC 8A 08     1310        CALL Z,PRINT
0116 18 AC        1320        JR   DISPLY
0118              1330 *
0118              1340 * "UPDATE" KEEPS TRACK OF MOVES MADE
0118              1350 *
0118 12           1360 UPDATE LD   (DE),A
0119 13           1370        INC  DE
011A 3E A0        1380        LD   A,240
011C 12           1390        LD   (DE),A
011D 0D           1400        DEC  C
011E C0           1410        RET  NZ
011F 11 7F 07     1420        LD   DE,MOVES
0122 0E 71        1430        LD   C,113D
0124 EF           1440        RST  50
0125 18 9D        1450        JR   DISPLY
0127              1460 *
0127              1470 * U = UP SURFACE, CLOCKWISE ROTATION
0127              1480 *
0127 CF           1490 UPRT   RST  10
0128 3A F2 07     1500        LD   A,(U1)
012B 47           1510        LD   B,A
012C 3A FE 07     1520        LD   A,(U7)
012F 32 F2 07     1530        LD   (U1),A
0132 3A 02 08     1540        LD   A,(U9)
0135 32 FE 07     1550        LD   (U7),A
0138 3A F6 07     1560        LD   A,(U3)
013B 32 02 08     1570        LD   (U9),A
013E 78           1580        LD   A,B
013F 32 F6 07     1590        LD   (U3),A
0142 3A F4 07     1600        LD   A,(U2)
0145 47           1610        LD   B,A
0146 3A F8 07     1620        LD   A,(U4)
0149 32 F4 07     1630        LD   (U2),A
014C 3A 00 08     1640        LD   A,(U8)
014F 32 F8 07     1650        LD   (U4),A
0152 3A FC 07     1660        LD   A,(U6)
0155 32 00 08     1670        LD   (U8),A
0158 78           1680        LD   A,B
0159 32 FC 07     1690        LD   (U6),A
015C 3A 04 08     1700        LD   A,(L1)
015F 47           1710        LD   B,A
0160 3A 0A 08     1720        LD   A,(F1)
0163 32 04 08     1730        LD   (L1),A
0166 3A 10 08     1740        LD   A,(R1)
0169 32 0A 08     1750        LD   (F1),A
016C 3A 16 08     1760        LD   A,(B1)
016F 32 10 08     1770        LD   (R1),A
0172 78           1780        LD   A,B
0173 32 16 08     1790        LD   (B1),A
0176 3A 06 08     1800        LD   A,(L2)
0179 47           1810        LD   B,A
017A 3A 0C 08     1820        LD   A,(F2)
017D 32 06 08     1830        LD   (L2),A
0180 3A 12 08     1840        LD   A,(R2)
0183 32 0C 08     1850        LD   (F2),A
0186 3A 18 08     1860        LD   A,(B2)
0189 32 12 08     1870        LD   (R2),A
018C 78           1880        LD   A,B
018D 32 18 08     1890        LD   (B2),A
0190 3A 08 08     1900        LD   A,(L3)
0193 47           1910        LD   B,A
0194 3A 0E 08     1920        LD   A,(F3)
0197 32 08 08     1930        LD   (L3),A
019A 3A 14 08     1940        LD   A,(R3)
019D 32 0E 08     1950        LD   (F3),A
01A0 3A 1A 08     1960        LD   A,(B3)
01A3 32 14 08     1970        LD   (R3),A
01A6 78           1980        LD   A,B
01A7 32 1A 08     1990        LD   (B3),A
01AA C3 C4 00     2000        JP   DISPLY
01AD              2010 *
01AD              2020 * u = UP SURFACE, COUNTERCLOCKWISE
01AD              2030 *
01AD CF           2040 UPLT   RST  10
01AE 3A F2 07     2050        LD   A,(U1)
01B1 47           2060        LD   B,A
01B2 3A F6 07     2070        LD   A,(U3)
01B5 32 F2 07     2080        LD   (U1),A
01B8 3A 02 08     2090        LD   A,(U9)
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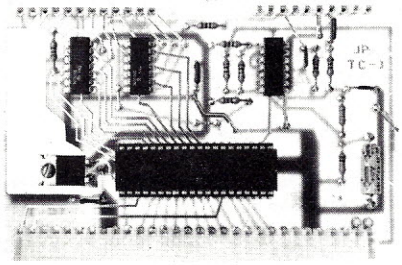

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01BB 32 F6 07     2100        LD   (U3),A
01BE 3A FE 07     2110        LD   A,(U7)
01C1 32 02 08     2120        LD   (U9),A
01C4 78           2130        LD   A,B
01C5 32 FE 07     2140        LD   (U7),A
01C8 3A F4 07     2150        LD   A,(U2)
01CB 47           2160        LD   B,A
01CC 3A FC 07     2170        LD   A,(U6)
01CF 32 F4 07     2180        LD   (U2),A
01D2 3A 00 08     2190        LD   A,(U8)
01D5 32 FC 07     2200        LD   (U6),A
01D8 3A F8 07     2210        LD   A,(U4)
01DB 32 00 08     2220        LD   (U8),A
01DE 78           2230        LD   A,B
01DF 32 F8 07     2240        LD   (U4),A
01E2 3A 04 08     2250        LD   A,(L1)
01E5 47           2260        LD   B,A
01E6 3A 16 08     2270        LD   A,(B1)
01E9 32 04 08     2280        LD   (L1),A
01EC 3A 10 08     2290        LD   A,(R1)
01EF 32 16 08     2300        LD   (B1),A
01F2 3A 0A 08     2310        LD   A,(F1)
01F5 32 10 08     2320        LD   (R1),A
01F8 78           2330        LD   A,B
01F9 32 0A 08     2340        LD   (F1),A
01FC 3A 06 08     2350        LD   A,(L2)
01FF 47           2360        LD   B,A
0200 3A 18 08     2370        LD   A,(B2)
0203 32 06 08     2380        LD   (L2),A
0206 3A 12 08     2390        LD   A,(R2)
0209 32 18 08     2400        LD   (B2),A
020C 3A 0C 08     2410        LD   A,(F2)
020F 32 12 08     2420        LD   (R2),A
0212 78           2430        LD   A,B
0213 32 0C 08     2440        LD   (F2),A
0216 3A 08 08     2450        LD   A,(L3)
0219 47           2460        LD   B,A
021A 3A 1A 08     2470        LD   A,(B3)
021D 32 08 08     2480        LD   (L3),A
0220 3A 14 08     2490        LD   A,(R3)
0223 32 1A 08     2500        LD   (B3),A
0226 3A 0E 08     2510        LD   A,(F3)
0229 32 14 08     2520        LD   (R3),A
022C 78           2530        LD   A,B
022D 32 0E 08     2540        LD   (F3),A
0230 C3 C4 00     2550        JP   DISPLY
0233              2560 *
0233              2570 * D = DOWN SURFACE, CLOCKWISE
0233              2580 *
0233 CF           2590 DNRT   RST  10
0234 3A 4C 08     2600        LD   A,(D1)
0237 47           2610        LD   B,A
0238 3A 58 08     2620        LD   A,(D7)
023B 32 4C 08     2630        LD   (D1),A
023E 3A 5C 08     2640        LD   A,(D9)
0241 32 58 08     2650        LD   (D7),A
0244 3A 50 08     2660        LD   A,(D3)
0247 32 5C 08     2670        LD   (D9),A
024A 78           2680        LD   A,B
024B 32 50 08     2690        LD   (D3),A
024E 3A 4E 08     2700        LD   A,(D2)
0251 47           2710        LD   B,A
0252 3A 52 08     2720        LD   A,(D4)
0255 32 4E 08     2730        LD   (D2),A
0258 3A 5A 08     2740        LD   A,(D8)
025B 32 52 08     2750        LD   (D4),A
025E 3A 56 08     2760        LD   A,(D6)
0261 32 5A 08     2770        LD   (D8),A
0264 78           2780        LD   A,B
0265 32 56 08     2790        LD   (D6),A
0268 3A 34 08     2800        LD   A,(L7)
026B 47           2810        LD   B,A
026C 3A 46 08     2820        LD   A,(B7)
026F 32 34 08     2830        LD   (L7),A
0272 3A 40 08     2840        LD   A,(R7)
0275 32 46 08     2850        LD   (B7),A
0278 3A 3A 08     2860        LD   A,(F7)
027B 32 40 08     2870        LD   (R7),A
027E 78           2880        LD   A,B
027F 32 3A 08     2890        LD   (F7),A
0282 3A 36 08     2900        LD   A,(L8)
0285 47           2910        LD   B,A
0286 3A 48 08     2920        LD   A,(B8)
0289 32 36 08     2930        LD   (L8),A
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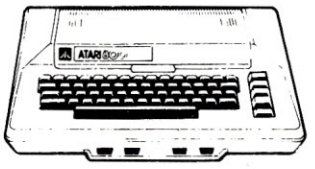

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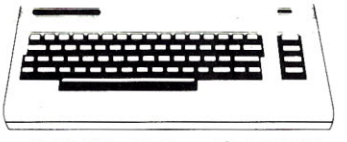

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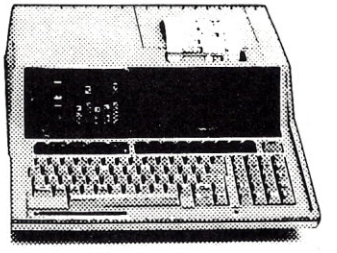

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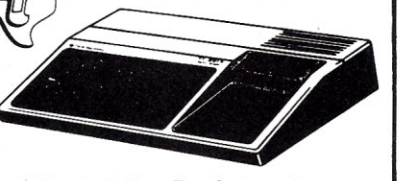

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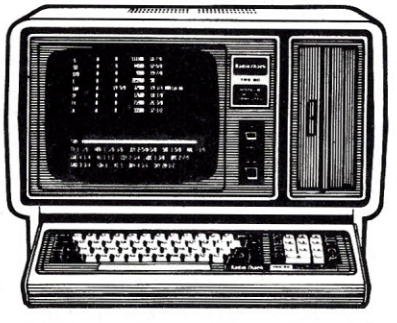

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Listing 2 continued.

```
028C 3A 42 08      2940          LD   A,(R8)
028F 32 48 08      2950          LD   (B8),A
0292 3A 3C 08      2960          LD   A,(F8)
0295 32 42 08      2970          LD   (R8),A
0298 78            2980          LD   A,B
0299 32 3C 08      2990          LD   (F8),A
029C 3A 38 08      3000          LD   A,(L9)
029F 47            3010          LD   B,A
02A0 3A 4A 08      3020          LD   A,(B9)
02A3 32 38 08      3030          LD   (L9),A
02A6 3A 44 08      3040          LD   A,(R9)
02A9 32 4A 08      3050          LD   (B9),A
02AC 3A 3E 08      3060          LD   A,(F9)
02AF 32 44 08      3070          LD   (R9),A
02B2 78            3080          LD   A,B
02B3 32 3E 08      3090          LD   (F9),A
02B6 C3 C4 00      3100          JP   DISPLY
02B9               3110 *
02B9               3120 * d = DOWN SURFACE, COUNTERCLOCKWISE
02B9               3130 *
02B9 CF            3140 DNLT     RST  10
02BA 3A 4C 08      3150          LD   A,(D1)
02BD 47            3160          LD   B,A
02BE 3A 50 08      3170          LD   A,(D3)
02C1 32 4C 08      3180          LD   (D1),A
02C4 3A 5C 08      3190          LD   A,(D9)
02C7 32 50 08      3200          LD   (D3),A
02CA 3A 58 08      3210          LD   A,(D7)
02CD 32 5C 08      3220          LD   (D9),A
02D0 78            3230          LD   A,B
02D1 32 58 08      3240          LD   (D7),A
02D4 3A 4E 08      3250          LD   A,(D2)
02D7 47            3260          LD   B,A
02D8 3A 56 08      3270          LD   A,(D6)
02DB 32 4E 08      3280          LD   (D2),A
02DE 3A 5A 08      3290          LD   A,(D8)
02E1 32 56 08      3300          LD   (D6),A
02E4 3A 52 08      3310          LD   A,(D4)
02E7 32 5A 08      3320          LD   (D8),A
02EA 78            3330          LD   A,B
02EB 32 52 08      3340          LD   (D4),A
02EE 3A 34 08      3350          LD   A,(L7)
02F1 47            3360          LD   B,A
02F2 3A 3A 08      3370          LD   A,(F7)
02F5 32 34 08      3380          LD   (L7),A
02F8 3A 40 08      3390          LD   A,(R7)
02FB 32 3A 08      3400          LD   (F7),A
02FE 3A 46 08      3410          LD   A,(B7)
0301 32 40 08      3420          LD   (R7),A
0304 78            3430          LD   A,B
0305 32 46 08      3440          LD   (B7),A
0308 3A 36 08      3450          LD   A,(L8)
030B 47            3460          LD   B,A
030C 3A 3C 08      3470          LD   A,(F8)
030F 32 36 08      3480          LD   (L8),A
0312 3A 42 08      3490          LD   A,(R8)
0315 32 3C 08      3500          LD   (F8),A
0318 3A 48 08      3510          LD   A,(B8)
031B 32 42 08      3520          LD   (R8),A
031E 78            3530          LD   A,B
031F 32 48 08      3540          LD   (B8),A
0322 3A 38 08      3550          LD   A,(L9)
0325 47            3560          LD   B,A
0326 3A 3E 08      3570          LD   A,(F9)
0329 32 38 08      3580          LD   (L9),A
032C 3A 44 08      3590          LD   A,(R9)
032F 32 3E 08      3600          LD   (F9),A
0332 3A 4A 08      3610          LD   A,(B9)
0335 32 44 08      3620          LD   (R9),A
0338 78            3630          LD   A,B
0339 32 4A 08      3640          LD   (B9),A
033C C3 C4 00      3650          JP   DISPLY
033F               3660 *
033F               3670 * L = LEFT SURFACE, CLOCKWISE
033F               3680 *
033F CF            3690 LTRT     RST  10
0340 3A 04 08      3700          LD   A,(L1)
0343 47            3710          LD   B,A
0344 3A 34 08      3720          LD   A,(L7)
0347 32 04 08      3730          LD   (L1),A
034A 3A 38 08      3740          LD   A,(L9)
034D 32 34 08      3750          LD   (L7),A
0350 3A 08 08      3760          LD   A,(L3)
0353 32 38 08      3770          LD   (L9),A
```

More →

Listing 2 continued.

```
0356 78          3780        LD   A,B
0357 32 08 08    3790        LD   (L3),A
035A 3A 06 08    3800        LD   A,(L2)
035D 47          3810        LD   B,A
035E 3A 1C 08    3820        LD   A,(L4)
0361 32 06 08    3830        LD   (L2),A
0364 3A 36 08    3840        LD   A,(L8)
0367 32 1C 08    3850        LD   (L4),A
036A 3A 20 08    3860        LD   A,(L6)
036D 32 36 08    3870        LD   (L8),A
0370 78          3880        LD   A,B
0371 32 20 08    3890        LD   (L6),A
0374 3A F2 07    3900        LD   A,(U1)
0377 47          3910        LD   B,A
0378 3A 4A 08    3920        LD   A,(B9)
037B 32 F2 07    3930        LD   (U1),A
037E 3A 4C 08    3940        LD   A,(D1)
0381 32 4A 08    3950        LD   (B9),A
0384 3A 0A 08    3960        LD   A,(F1)
0387 32 4C 08    3970        LD   (D1),A
038A 78          3980        LD   A,B
038B 32 0A 08    3990        LD   (F1),A
038E 3A F8 07    4000        LD   A,(U4)
0391 47          4010        LD   B,A
0392 3A 32 08    4020        LD   A,(B6)
0395 32 F8 07    4030        LD   (U4),A
0398 3A 52 08    4040        LD   A,(D4)
039B 32 32 08    4050        LD   (B6),A
039E 3A 22 08    4060        LD   A,(F4)
03A1 32 52 08    4070        LD   (D4),A
03A4 78          4080        LD   A,B
03A5 32 22 08    4090        LD   (F4),A
03A8 3A FE 07    4100        LD   A,(U7)
03AB 47          4110        LD   B,A
03AC 3A 1A 08    4120        LD   A,(B3)
03AF 32 FE 07    4130        LD   (U7),A
03B2 3A 58 08    4140        LD   A,(D7)
03B5 32 1A 08    4150        LD   (B3),A
03B8 3A 3A 08    4160        LD   A,(F7)
03BB 32 58 08    4170        LD   (D7),A
03BE 78          4180        LD   A,B
03BF 32 3A 08    4190        LD   (F7),A
03C2 C3 C4 00    4200        JP   DISPLY
03C5             4210 *
03C5             4220 * 1 = LEFT SURFACE, COUNTERCLOCKWISE
03C5             4230 *
03C5 CF          4240 LTLT   RST  10
03C6 3A 04 08    4250        LD   A,(L1)
03C9 47          4260        LD   B,A
03CA 3A 08 08    4270        LD   A,(L3)
03CD 32 04 08    4280        LD   (L1),A
03D0 3A 38 08    4290        LD   A,(L9)
03D3 32 08 08    4300        LD   (L3),A
03D6 3A 34 08    4310        LD   A,(L7)
03D9 32 38 08    4320        LD   (L9),A
03DC 78          4330        LD   A,B
03DD 32 34 08    4340        LD   (L7),A
03E0 3A 06 08    4350        LD   A,(L2)
03E3 47          4360        LD   B,A
03E4 3A 20 08    4370        LD   A,(L6)
03E7 32 06 08    4380        LD   (L2),A
03EA 3A 36 08    4390        LD   A,(L8)
03ED 32 20 08    4400        LD   (L6),A
03F0 3A 1C 08    4410        LD   A,(L4)
03F3 32 36 08    4420        LD   (L8),A
03F6 78          4430        LD   A,B
03F7 32 1C 08    4440        LD   (L4),A
03FA 3A F2 07    4450        LD   A,(U1)
03FD 47          4460        LD   B,A
03FE 3A 0A 08    4470        LD   A,(F1)
0401 32 F2 07    4480        LD   (U1),A
0404 3A 4C 08    4490        LD   A,(D1)
0407 32 0A 08    4500        LD   (F1),A
040A 3A 4A 08    4510        LD   A,(B9)
040D 32 4C 08    4520        LD   (D1),A
0410 78          4530        LD   A,B
0411 32 4A 08    4540        LD   (B9),A
0414 3A F8 07    4550        LD   A,(U4)
0417 47          4560        LD   B,A
0418 3A 22 08    4570        LD   A,(F4)
041B 32 F8 07    4580        LD   (U4),A
041E 3A 52 08    4590        LD   A,(D4)
0421 32 22 08    4600        LD   (F4),A
0424 3A 32 08    4610        LD   A,(B6)
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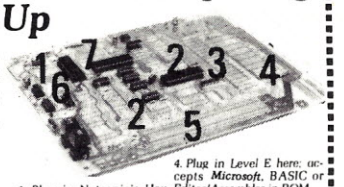

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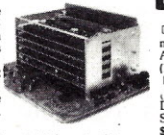

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☐ S100 bus connectors (five required) . . . **$4.85** each, postpaid.

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(from page 35)

caution: most patterns are not simple, and trying can be addictive!

Future Prospects

While it is beyond the scope of the programs offered here, far greater capability for Rubik's Cube simulation can be achieved. For example, a simple utility might be devised to preset a desired pattern on each face; this would be useful in discovering routines to move from one arrangement to another, or in unscrambling a scrambled Cube. Naturally, care would have to be exercised to ensure that "fixed adjacencies" (the invariable relationships at edges and corners) are not violated in such a preset capability.

Readers with more sophisticated graphics capability may wish to pursue some of the obvious extensions suggested by the basic concepts. The possibilities promised by full color and/or 3-D graphics are truly exciting.

Conclusion

While this application certainly falls into the games category, these are not game programs in the usual

Listing 2 continued.

```
0427 32 52 08      4620        LD   (D4),A
042A 78            4630        LD   A,B
042B 32 32 08      4640        LD   (B6),A
042E 3A FE 07      4650        LD   A,(U7)
0431 47            4660        LD   B,A
0432 3A 3A 08      4670        LD   A,(F7)
0435 32 FE 07      4680        LD   (U7),A
0438 3A 58 08      4690        LD   A,(D7)
043B 32 3A 08      4700        LD   (F7),A
043E 3A 1A 08      4710        LD   A,(B3)
0441 32 58 08      4720        LD   (D7),A
0444 78            4730        LD   A,B
0445 32 1A 08      4740        LD   (B3),A
0448 C3 C4 00      4750        JP   DISPLY
044B               4760 *
044B               4770 * R = RIGHT SURFACE, CLOCKWISE
044B               4780 *
044B CF            4790 RTRT   RST  10
044C 3A 10 08      4800        LD   A,(R1)
044F 47            4810        LD   B,A
0450 3A 40 08      4820        LD   A,(R7)
0453 32 10 08      4830        LD   (R1),A
0456 3A 44 08      4840        LD   A,(R9)
0459 32 40 08      4850        LD   (R7),A
045C 3A 14 08      4860        LD   A,(R3)
045F 32 44 08      4870        LD   (R9),A
0462 78            4880        LD   A,B
0463 32 14 08      4890        LD   (R3),A
0466 3A 12 08      4900        LD   A,(R2)
0469 47            4910        LD   B,A
046A 3A 28 08      4920        LD   A,(R4)
046D 32 12 08      4930        LD   (R2),A
0470 3A 42 08      4940        LD   A,(R8)
0473 32 28 08      4950        LD   (R4),A
0476 3A 2C 08      4960        LD   A,(R6)
0479 32 42 08      4970        LD   (R8),A
047C 78            4980        LD   A,B
047D 32 2C 08      4990        LD   (R6),A
```

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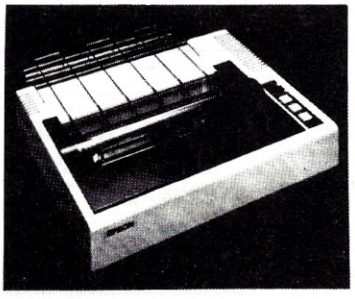

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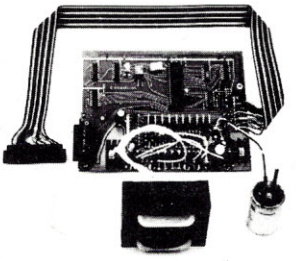

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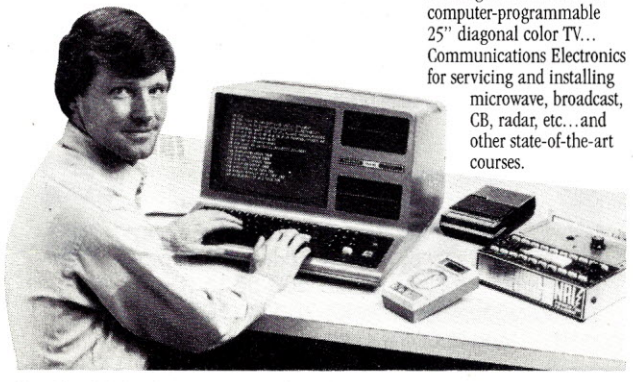

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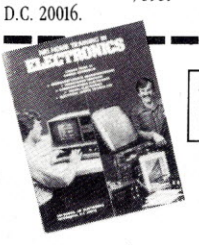

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sense. More properly, they are problem-solving tools, representative of ways computers are used in scientific and engineering applications in industry and research. As with most computer applications, potential extensions to these programs range from the obvious and simple to the subtle and sophisticated.

In the *Scientific American* article, Hofstadter loosely associates Rubik's Cube with the once-popular and much older two-dimensional Fifteen Puzzle. An article and TRS-80 BASIC program for that puzzle, written by William L. Colsher, appeared in the February 1981 issue of *Microcomputing*. As awesome as the number of Fifteen Puzzle solutions may appear, Rubik's Cube makes the Fifteen Puzzle seem trivial by contrast: the cube has more than four million times as many solutions!

Even with the best of computer technology, it is improbable that every cube solution will ever be achieved. One hundred million computerized cubists, each producing solutions at the rate of one per second, would require more than 13,000 years to complete the task.■

Listing 2 continued.

```
0480 3A F6 07     5000        LD   A,(U3)
0483 47           5010        LD   B,A
0484 3A 0E 08     5020        LD   A,(F3)
0487 32 F6 07     5030        LD   (U3),A
048A 3A 50 08     5040        LD   A,(D3)
048D 32 0E 08     5050        LD   (F3),A
0490 3A 46 08     5060        LD   A,(B7)
0493 32 50 08     5070        LD   (D3),A
0496 78           5080        LD   A,B
0497 32 46 08     5090        LD   (B7),A
049A 3A FC 07     5100        LD   A,(U6)
049D 47           5110        LD   B,A
049E 3A 26 08     5120        LD   A,(F6)
04A1 32 FC 07     5130        LD   (U6),A
04A4 3A 56 08     5140        LD   A,(D6)
04A7 32 26 08     5150        LD   (F6),A
04AA 3A 2E 08     5160        LD   A,(B4)
04AD 32 56 08     5170        LD   (D6),A
04B0 78           5180        LD   A,B
04B1 32 2E 08     5190        LD   (B4),A
04B4 3A 02 08     5200        LD   A,(U9)
04B7 47           5210        LD   B,A
04B8 3A 3E 08     5220        LD   A,(F9)
04BB 32 02 08     5230        LD   (U9),A
04BE 3A 5C 08     5240        LD   A,(D9)
04C1 32 3E 08     5250        LD   (F9),A
04C4 3A 16 08     5260        LD   A,(B1)
04C7 32 5C 08     5270        LD   (D9),A
04CA 78           5280        LD   A,B
04CB 32 16 08     5290        LD   (B1),A
04CE C3 C4 00     5300        JP   DISPLY
04D1              5310 *
04D1              5320 * r = RIGHT SURFACE, COUNTERCLOCKWISE
04D1              5330 *
04D1 CF           5340 RTLT   RST  10
04D2 3A 10 08     5350        LD   A,(R1)
04D5 47           5360        LD   B,A
04D6 3A 14 08     5370        LD   A,(R3)
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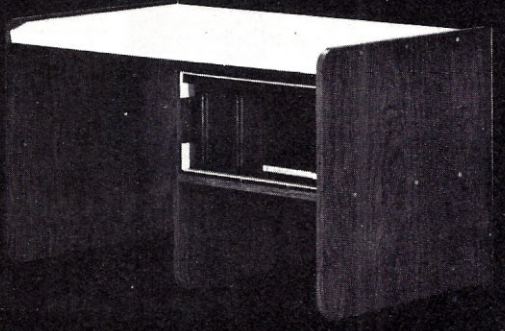

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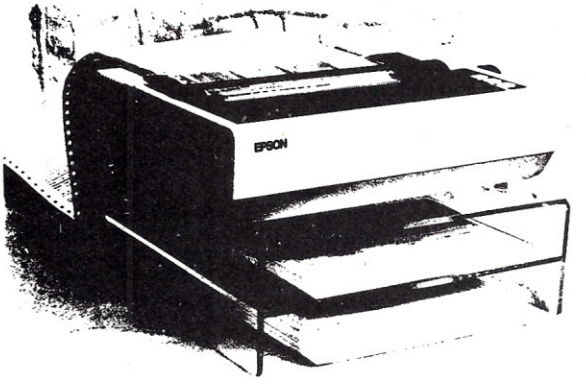

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04D9 32 10 08      5380        LD   (R1),A
04DC 3A 44 08      5390        LD   A,(R9)
04DF 32 14 08      5400        LD   (R3),A
04E2 3A 40 08      5410        LD   A,(R7)
04E5 32 44 08      5420        LD   (R9),A
04E8 78            5430        LD   A,B
04E9 32 40 08      5440        LD   (R7),A
04EC 3A 12 08      5450        LD   A,(R2)
04EF 47            5460        LD   B,A
04F0 3A 2C 08      5470        LD   A,(R6)
04F3 32 12 08      5480        LD   (R2),A
04F6 3A 42 08      5490        LD   A,(R8)
04F9 32 2C 08      5500        LD   (R6),A
04FC 3A 28 08      5510        LD   A,(R4)
04FF 32 42 08      5520        LD   (R8),A
0502 78            5530        LD   A,B
0503 32 28 08      5540        LD   (R4),A
0506 3A F6 07      5550        LD   A,(U3)
0509 47            5560        LD   B,A
050A 3A 46 08      5570        LD   A,(B7)
050D 32 F6 07      5580        LD   (U3),A
0510 3A 50 08      5590        LD   A,(D3)
0513 32 46 08      5600        LD   (B7),A
0516 3A 0E 08      5610        LD   A,(F3)
0519 32 50 08      5620        LD   (D3),A
051C 78            5630        LD   A,B
051D 32 0E 08      5640        LD   (F3),A
0520 3A FC 07      5650        LD   A,(U6)
0523 47            5660        LD   B,A
0524 3A 2E 08      5670        LD   A,(B4)
0527 32 FC 07      5680        LD   (U6),A
052A 3A 56 08      5690        LD   A,(D6)
052D 32 2E 08      5700        LD   (B4),A
0530 3A 26 08      5710        LD   A,(F6)
0533 32 56 08      5720        LD   (D6),A
0536 78            5730        LD   A,B
0537 32 26 08      5740        LD   (F6),A
053A 3A 02 08      5750        LD   A,(U9)
053D 47            5760        LD   B,A
053E 3A 16 08      5770        LD   A,(B1)
0541 32 02 08      5780        LD   (U9),A
0544 3A 5C 08      5790        LD   A,(D9)
0547 32 16 08      5800        LD   (B1),A
054A 3A 3E 08      5810        LD   A,(F9)
054D 32 5C 08      5820        LD   (D9),A
0550 78            5830        LD   A,B
0551 32 3E 08      5840        LD   (F9),A
0554 C3 C4 00      5850        JP   DISPLY
0557               5860 *
0557               5870 * F = FRONT SURFACE, CLOCKWISE
0557               5880 *
0557 CF            5890 FRRT   RST  10
0558 3A 0A 08      5900        LD   A,(F1)
055B 47            5910        LD   B,A
055C 3A 3A 08      5920        LD   A,(F7)
055F 32 0A 08      5930        LD   (F1),A
0562 3A 3E 08      5940        LD   A,(F9)
0565 32 3A 08      5950        LD   (F7),A
0568 3A 0E 08      5960        LD   A,(F3)
056B 32 3E 08      5970        LD   (F9),A
056E 78            5980        LD   A,B
056F 32 0E 08      5990        LD   (F3),A
0572 3A 0C 08      6000        LD   A,(F2)
0575 47            6010        LD   B,A
0576 3A 22 08      6020        LD   A,(F4)
0579 32 0C 08      6030        LD   (F2),A
057C 3A 3C 08      6040        LD   A,(F8)
057F 32 22 08      6050        LD   (F4),A
0582 3A 26 08      6060        LD   A,(F6)
0585 32 3C 08      6070        LD   (F8),A
0588 78            6080        LD   A,B
0589 32 26 08      6090        LD   (F6),A
058C 3A FE 07      6100        LD   A,(U7)
058F 47            6110        LD   B,A
0590 3A 38 08      6120        LD   A,(L9)
0593 32 FE 07      6130        LD   (U7),A
0596 3A 50 08      6140        LD   A,(D3)
0599 32 38 08      6150        LD   (L9),A
059C 3A 10 08      6160        LD   A,(R1)
059F 32 50 08      6170        LD   (D3),A
05A2 78            6180        LD   A,B
05A3 32 10 08      6190        LD   (R1),A
05A6 3A 00 08      6200        LD   A,(U8)
05A9 47            6210        LD   B,A
```

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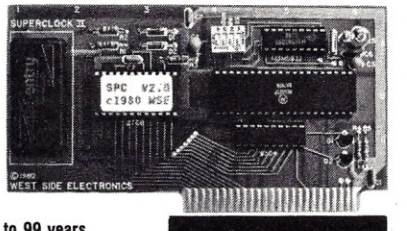

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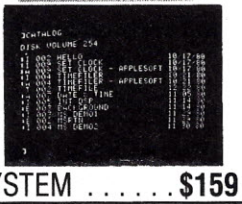

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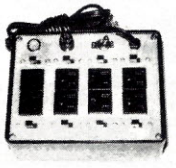

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```
05AA 3A 20 08     6220        LD   A,(L6)
05AD 32 00 08     6230        LD   (U8),A
05B0 3A 4E 08     6240        LD   A,(D2)
05B3 32 20 08     6250        LD   (L6),A
05B6 3A 28 08     6260        LD   A,(R4)
05B9 32 4E 08     6270        LD   (D2),A
05BC 78           6280        LD   A,B
05BD 32 28 08     6290        LD   (R4),A
05C0 3A 02 08     6300        LD   A,(U9)
05C3 47           6310        LD   B,A
05C4 3A 08 08     6320        LD   A,(L3)
05C7 32 02 08     6330        LD   (U9),A
05CA 3A 4C 08     6340        LD   A,(D1)
05CD 32 08 08     6350        LD   (L3),A
05D0 3A 40 08     6360        LD   A,(R7)
05D3 32 4C 08     6370        LD   (D1),A
05D6 78           6380        LD   A,B
05D7 32 40 08     6390        LD   (R7),A
05DA C3 C4 00     6400        JP   DISPLY
05DD              6410 *
05DD              6420 * f = FRONT SURFACE, COUNTERCLOCKWISE
05DD              6430 *
05DD CF           6440 FRLT   RST  10
05DE 3A 0A 08     6450        LD   A,(F1)
05E1 47           6460        LD   B,A
05E2 3A 0E 08     6470        LD   A,(F3)
05E5 32 0A 08     6480        LD   (F1),A
05E8 3A 3E 08     6490        LD   A,(F9)
05EB 32 0E 08     6500        LD   (F3),A
05EE 3A 3A 08     6510        LD   A,(F7)
05F1 32 3E 08     6520        LD   (F9),A
05F4 78           6530        LD   A,B
05F5 32 3A 08     6540        LD   (F7),A
05F8 3A 0C 08     6550        LD   A,(F2)
05FB 47           6560        LD   B,A
05FC 3A 26 08     6570        LD   A,(F6)
05FF 32 0C 08     6580        LD   (F2),A
0602 3A 3C 08     6590        LD   A,(F8)
0605 32 26 08     6600        LD   (F6),A
0608 3A 22 08     6610        LD   A,(F4)
060B 32 3C 08     6620        LD   (F8),A
060E 78           6630        LD   A,B
060F 32 22 08     6640        LD   (F4),A
0612 3A FE 07     6650        LD   A,(U7)
0615 47           6660        LD   B,A
0616 3A 10 08     6670        LD   A,(R1)
0619 32 FE 07     6680        LD   (U7),A
061C 3A 50 08     6690        LD   A,(D3)
061F 32 10 08     6700        LD   (R1),A
0622 3A 38 08     6710        LD   A,(L9)
0625 32 50 08     6720        LD   (D3),A
0628 78           6730        LD   A,B
0629 32 38 08     6740        LD   (L9),A
062C 3A 00 08     6750        LD   A,(U8)
062F 47           6760        LD   B,A
0630 3A 28 08     6770        LD   A,(R4)
0633 32 00 08     6780        LD   (U8),A
0636 3A 4E 08     6790        LD   A,(D2)
0639 32 28 08     6800        LD   (R4),A
063C 3A 20 08     6810        LD   A,(L6)
063F 32 4E 08     6820        LD   (D2),A
0642 78           6830        LD   A,B
0643 32 20 08     6840        LD   (L6),A
0646 3A 02 08     6850        LD   A,(U9)
0649 47           6860        LD   B,A
064A 3A 40 08     6870        LD   A,(R7)
064D 32 02 08     6880        LD   (U9),A
0650 3A 4C 08     6890        LD   A,(D1)
0653 32 40 08     6900        LD   (R7),A
0656 3A 08 08     6910        LD   A,(L3)
0659 32 4C 08     6920        LD   (D1),A
065C 78           6930        LD   A,B
065D 32 08 08     6940        LD   (L3),A
0660 C3 C4 00     6950        JP   DISPLY
0663              6960 *
0663              6970 * B = BACK SURFACE, CLOCKWISE
0663              6980 *
0663 CF           6990 BKRT   RST  10
0664 3A 16 08     7000        LD   A,(B1)
0667 47           7010        LD   B,A
0668 3A 46 08     7020        LD   A,(B7)
066B 32 16 08     7030        LD   (B1),A
066E 3A 4A 08     7040        LD   A,(B9)
0671 32 46 08     7050        LD   (B7),A
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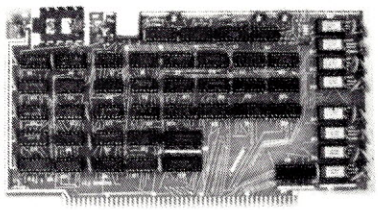

For the S-100 Bus. 32K of on board memory allows a 288 H. x 192V. dot matrix, for a total of 55,296 pixels. Every pixel is programable in any one of 16 colors or 16 grey levels completely independent of all other pixels in the matrix.

Compuprism Bare Board with documentation $45, kit $240, ass. and tested $280. (16K Memory 144H. x 192V.)

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Add $15 to A & T price for 16 level grey scale.
Add $15 to A & T price for memory management port.

Compuprism software package, includes alpa-numberics, point plot, line draw, and TRS-80* graphics simulation $20 or FREE with A & T unit.

Z-80 Users You Can Use TRS-80* Software

We offer an assembled hardware interface which we guarantee will load data from TRS-80* cassettes into any Z-80 based system. (Except sealed units.) The documentation explains how to patch the TRS-80* software to your system. In fact you can virtually change your Z-80 machine into a TRS-80* without making a single hardware change. The documentation also includes an example of patching SARGON II** into a Z-80 system.

The price is $30 or FREE with the purchase of an assembled compuprism or super compuprism unit.

A-D, D-A Board

S-100 board provides 16 channels of analog to digital input and 8 channels of digital to analog output. With on board kluge area. Total cost of board and parts less than $120. Bare board with documentation $45.

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TRS-80* is a trademark of Tandy Corp.
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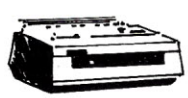

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	List	Sell
3510-1 30CPS Serial	2450	2050
7710-1 55CPS SERIAL	CALL	CALL
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HR2-2D-64K	4195	2849
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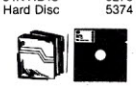
HR2-1Q-64K-HD5	6695	4999
HR2-1Q-64K-HD18	9270	6749
HDS-18 Hard Disc	5374	3890



NORTHSTAR SOFTWARE

	List	Sell
Northword D/Q	399	295
Mailmanager D/Q	299	235
Infomanager D/Q	499	365
General Ledger D/Q	999	795
A/R D/Q	599	475
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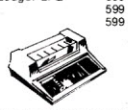

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	List	Sell
TI-810 BASIC	1645	1398
TI-810 Full ASCII	1745	1479
TI-810 Package	1945	1649
TI-820 R/O BASIC	1995	1625
TI-820 KSR Package	2395	1950

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PIO Board	200	CALL
FPB Board	399	CALL
Graphics Option	299	CALL

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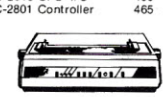
2800 Computer	5035	3595
DM-6400 Memory	760	585
DMB-6400 Memory	995	735
CPC-2813 CPU+I/O	460	365
FDC-2801 Controller	465	370



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	List	Sell
Sprint 9 35CPS R/O	1995	1700
Sprint 9 45CPS R/O	2300	2000
Sprint 9 55CPS R/O	2400	2050
Full Control Option	155	150
Memory Option	150	150

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Decision 1 BASIC	1725	1350
Decision 2	CALL	CALL
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Switchboard I/O	259	210

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Discus 2D 1 Drive	1095	849
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Cat Modem	189	140
D-Cat	199	150
Auto-Cat	249	190
Apple-Cat	389	310
DC Hayes Micro-100	379	330

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VM-121 Green Monitor	160	CALL
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Z-89 Computer	2895	CALL
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Spellstar	250	190
Mailmerge	150	100
Datastar	350	250
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	List	Sell
Memorex 5" 1D	47	27
Memorex 5" 2D	55	36
Memorex 8" 1D	65	40
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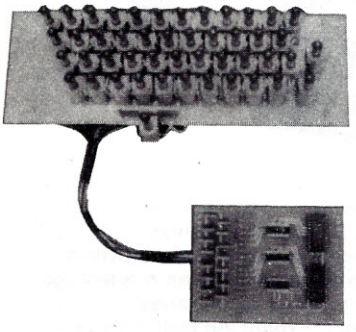

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✓353

Listing 2 continued.

```
0674 3A 1A 08     7060        LD   A,(B3)
0677 32 4A 08     7070        LD   (B9),A
067A 78           7080        LD   A,B
067B 32 1A 08     7090        LD   (B3),A
067E 3A 18 08     7100        LD   A,(B2)
0681 47           7110        LD   B,A
0682 3A 2E 08     7120        LD   A,(B4)
0685 32 18 08     7130        LD   (B2),A
0688 3A 48 08     7140        LD   A,(B8)
068B 32 2E 08     7150        LD   (B4),A
068E 3A 32 08     7160        LD   A,(B6)
0691 32 48 08     7170        LD   (B8),A
0694 78           7180        LD   A,B
0695 32 32 08     7190        LD   (B6),A
0698 3A F2 07     7200        LD   A,(U1)
069B 47           7210        LD   B,A
069C 3A 14 08     7220        LD   A,(R3)
069F 32 F2 07     7230        LD   (U1),A
06A2 3A 5C 08     7240        LD   A,(D9)
06A5 32 14 08     7250        LD   (R3),A
06A8 3A 34 08     7260        LD   A,(L7)
06AB 32 5C 08     7270        LD   (D9),A
06AE 78           7280        LD   A,B
06AF 32 34 08     7290        LD   (L7),A
06B2 3A F4 07     7300        LD   A,(U2)
06B5 47           7310        LD   B,A
06B6 3A 2C 08     7320        LD   A,(R6)
06B9 32 F4 07     7330        LD   (U2),A
06BC 3A 5A 08     7340        LD   A,(D8)
06BF 32 2C 08     7350        LD   (R6),A
06C2 3A 1C 08     7360        LD   A,(L4)
06C5 32 5A 08     7370        LD   (D8),A
06C8 78           7380        LD   A,B
06C9 32 1C 08     7390        LD   (L4),A
06CC 3A F6 07     7400        LD   A,(U3)
06CF 47           7410        LD   B,A
06D0 3A 44 08     7420        LD   A,(R9)
06D3 32 F6 07     7430        LD   (U3),A
06D6 3A 58 08     7440        LD   A,(D7)
06D9 32 44 08     7450        LD   (R9),A
06DC 3A 04 08     7460        LD   A,(L1)
06DF 32 58 08     7470        LD   (D7),A
06E2 78           7480        LD   A,B
06E3 32 04 08     7490        LD   (L1),A
06E6 C3 C4 00     7500        JP   DISPLY
06E9              7510 *
06E9              7520 * b = BACK SURFACE, COUNTERCLOCKWISE
06E9              7530 *
06E9 CF           7540 BKLT   RST  10
06EA 3A 16 08     7550        LD   A,(B1)
06ED 47           7560        LD   B,A
06EE 3A 1A 08     7570        LD   A,(B3)
06F1 32 16 08     7580        LD   (B1),A
06F4 3A 4A 08     7590        LD   A,(B9)
06F7 32 1A 08     7600        LD   (B3),A
06FA 3A 46 08     7610        LD   A,(B7)
06FD 32 4A 08     7620        LD   (B9),A
0700 78           7630        LD   A,B
0701 32 46 08     7640        LD   (B7),A
0704 3A 18 08     7650        LD   A,(B2)
0707 47           7660        LD   B,A
0708 3A 32 08     7670        LD   A,(B6)
070B 32 18 08     7680        LD   (B2),A
070E 3A 48 08     7690        LD   A,(B8)
0711 32 32 08     7700        LD   (B6),A
0714 3A 2E 08     7710        LD   A,(B4)
0717 32 48 08     7720        LD   (B8),A
071A 78           7730        LD   A,B
071B 32 2E 08     7740        LD   (B4),A
071E 3A F2 07     7750        LD   A,(U1)
0721 47           7760        LD   B,A
0722 3A 34 08     7770        LD   A,(L7)
0725 32 F2 07     7780        LD   (U1),A
0728 3A 5C 08     7790        LD   A,(D9)
072B 32 34 08     7800        LD   (L7),A
072E 3A 14 08     7810        LD   A,(R3)
0731 32 5C 08     7820        LD   (D9),A
0734 78           7830        LD   A,B
0735 32 14 08     7840        LD   (R3),A
0738 3A F4 07     7850        LD   A,(U2)
073B 47           7860        LD   B,A
073C 3A 1C 08     7870        LD   A,(L4)
073F 32 F4 07     7880        LD   (U2),A
0742 3A 5A 08     7890        LD   A,(D8)
```

More →

Listing 2 continued.

```
0745 32 1C 08      7900        LD   (L4),A
0748 3A 2C 08      7910        LD   A,(R6)
074B 32 5A 08      7920        LD   (D8),A
074E 78            7930        LD   A,B
074F 32 2C 08      7940        LD   (R6),A
0752 3A F6 07      7950        LD   A,(U3)
0755 47            7960        LD   B,A
0756 3A 04 08      7970        LD   A,(L1)
0759 32 F6 07      7980        LD   (U3),A
075C 3A 58 08      7990        LD   A,(D7)
075F 32 04 08      8000        LD   (L1),A
0762 3A 44 08      8010        LD   A,(R9)
0765 32 58 08      8020        LD   (D7),A
0768 78            8030        LD   A,B
0769 32 44 08      8040        LD   (R9),A
076C C3 C4 00      8050        JP   DISPLY
076F               8060 *
076F               8070 * COMBINED DATA AND SCREEN FORMAT STORAGE AREA
076F               8080 *    * EDITOR INTERPRETS BYTES WITH MSB SET (200-376)
076F               8090 *    * AS CORRESPONDING ASCII CHARACTER; BYTES WITH
076F               8100 *    * MSB CLEAR (001-177) ARE INTERPRETED AS MULTIPLE
076F               8110 *    * SPACES.  "377" ERASES SCREEN.  "000" MARKS END
076F               8120 *    * OF MESSAGE.
076F               8130 *
076F               8140 SCREEN DB   377,'Move Sequence: '
  FF   CD   EF   F6   E5
  A0   D3   E5   F1   F5
  E5   EE   E3   E5   BA
  A0
077F               8150 MOVES  DB   '
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0
079F               8160        DB   '
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0
07BF               8170        DB   '
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0
07DF               8180        DB   '                    ',83D
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   A0   A0
  A0   A0   A0   53
07F2               8190 *
07F2               8200 * LABELS BELOW (U1, U2, ETC.) PERMIT ASSEMBLER
07F2               8210 *    * TO TREAT CORRESPONDING ADDRESSES AS
07F2               8220 *    * LOCATIONS OF LITERAL VARIABLES.
07F2               8230 *
07F2               8240 U1     DB   'U',2
  D5   02
07F4               8250 U2     DB   'U',2
  D5   02
07F6               8260 U3     DB   'U',57D
  D5   39
07F8               8270 U4     DB   'U',2
  D5   02
07FA               8280 U5     DB   'U',2
  D5   02
07FC               8290 U6     DB   'U',57D
  D5   39
07FE               8300 U7     DB   'U',2
  D5   02
0800               8310 U8     DB   'U',2
  D5   02
0802               8320 U9     DB   'U',110D
  D5   6E
0804               8330 L1     DB   'L',2
  CC   02
0806               8340 L2     DB   'L',2
```

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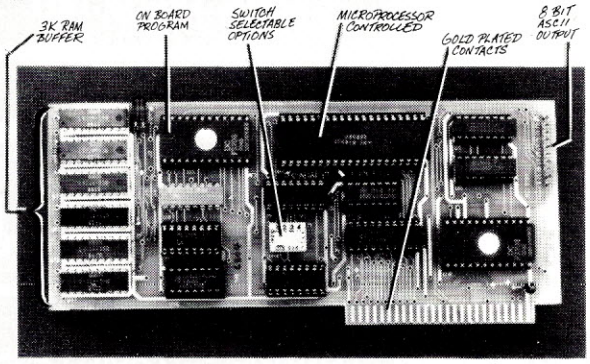

SMART II MICROPROCESSOR CONTROLLED PARALLEL PRINTER INTERFACE

Be Smart! With the new **SMART II** parallel printer interface for your Apple II* Computer you can have print spooling, left and right margin control, and adjustable tab stops. The **SMART II** can buffer over three thousand characters before it signals the Apple to stop sending. This eliminates the start - stop problem created with conventional printer cards and will keep your printer printing (instead of waiting).

The **SMART II** is compatible with all known hardware and software including the Pascal Language System, Microsoft Z-80 Softcard*, and Hayes Micromodem II*.

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Eight support ICs
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- 3K Print Spooler which acts much larger when spooling text because of a unique compaction routine
- On board software supports typewriter-like TAB Commands and has 16 software selectable TAB positions. Left and right margin commands are also software selectable to ease in the justification of reports and listings
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* Apple is a registered trademark of Apple Computer, Inc
* Z-80 Softcard is a registered trademark of Microsoft
* Micromodem II is a registered trademark of Hayes, Inc

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800-433-5184
Texas Residents 817-274-5625

Listing 2 continued.

```
CC   02
0808                    8350 L3     DB   'L',4
CC   04
080A                    8360 F1     DB   'F',2
C6   02
080C                    8370 F2     DB   'F',2
C6   02
080E                    8380 F3     DB   'F',4
C6   04
0810                    8390 R1     DB   'R',2
D2   02
0812                    8400 R2     DB   'R',2
D2   02
0814                    8410 R3     DB   'R',4
D2   04
0816                    8420 B1     DB   'B',2
C2   02
0818                    8430 B2     DB   'B',2
C2   02
081A                    8440 B3     DB   'B',24D
C2   18
081C                    8450 L4     DB   'L',2
CC   02
081E                    8460 L5     DB   'L',2
CC   02
0820                    8470 L6     DB   'L',4
CC   04
0822                    8480 F4     DB   'F',2
C6   02
0824                    8490 F5     DB   'F',2
C6   02
0826                    8500 F6     DB   'F',4
C6   04
0828                    8510 R4     DB   'R',2
D2   02
082A                    8520 R5     DB   'R',2
D2   02
082C                    8530 R6     DB   'R',4
D2   04
082E                    8540 B4     DB   'B',2
C2   02
0830                    8550 B5     DB   'B',2
C2   02
0832                    8560 B6     DB   'B',24D
C2   18
0834                    8570 L7     DB   'L',2
CC   02
0836                    8580 L8     DB   'L',2
CC   02
0838                    8590 L9     DB   'L',4
CC   04
083A                    8600 F7     DB   'F',2
C6   02
083C                    8610 F8     DB   'F',2
C6   02
083E                    8620 F9     DB   'F',4
C6   04
0840                    8630 R7     DB   'R',2
D2   02
0842                    8640 R8     DB   'R',2
D2   02
0844                    8650 R9     DB   'R',4
D2   04
0846                    8660 B7     DB   'B',2
C2   02
0848                    8670 B8     DB   'B',2
C2   02
084A                    8680 B9     DB   'B',99D
C2   63
084C                    8690 D1     DB   'D',2
C4   02
084E                    8700 D2     DB   'D',2
C4   02
0850                    8710 D3     DB   'D',57D
C4   39
0852                    8720 D4     DB   'D',2
C4   02
0854                    8730 D5     DB   'D',2
C4   02
0856                    8740 D6     DB   'D',57D
C4   39
0858                    8750 D7     DB   'D',2
C4   02
085A                    8760 D8     DB   'D',2
```

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20 SRT A$,LEN(A$),1\  REM Sort A$
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  C4   02
085C                8770 D9     DB   'D',101D,'Next Move: ',0
  C4   65   CE   E5   F8
  F4   A0   CD   EF   F6
  E5   BA   A0   00
086A                8780 *
086A                8790 * END OF MAIN PROGRAM
086A                8800 *
086A                8810 STACK  DS   32D
088A                8820 STAK   EQU  $
088A                8830 *
088A                8840 EDITOR EQU  343210       EDITS MESSAGE TO CRT
088A                8850 KEYIN  EQU  343152       RETURNS KEYSTROKE IN A
088A                8860 TRMOUT EQU  363160       OUTPUTS A CONTENTS TO CRT
088A                8870 MONITR EQU  340000       MONITOR/OPERATING SYSTEM
088A                8880 *
088A                8890 * PRINT ROUTINE - USER SHOULD SUPPLY APPROPRIATE
088A                8900 *                 ROUTINE TO REPRODUCE CONTENTS OF
088A                8910 *                 VIDEO DISPLAY ON HARDCOPY DEVICE
088A                8920 *
088A C5             8930 PRINT  PUSH BC
088B 21 AF F0       8940        LD   HL,PBUF+100
088E 22 D3 EF       8950        LD   (BFNDST+1),HL
0891 CD A3 E3       8960        CALL ERASE
0894 3E 0D          8970        LD   A,15
0896 F7             8980        RST  60
0897 32 1D F3       8990        LD   (PRTFLG),A
089A 21 70 07       9000        LD   HL,SCREEN+1
089D D7             9010        RST  20
089E AF             9020        XOR  A
089F 32 1D F3       9030        LD   (PRTFLG),A
08A2 21 CF F0       9040        LD   HL,BUFEND
08A5 22 D3 EF       9050        LD   (BFNDST+1),HL
08A8 06 09          9060        LD   B,9D
08AA 3E 0D          9070        LD   A,15
08AC F7             9080 FORMOT RST  60
08AD 10 FD          9090        DJNZ FORMOT
08AF C1             9100        POP  BC
08B0 C9             9110        RET
08B1                9120 *
08B1                9130 * JUMP/CALL TABLE OF SUBROUTINES IN
08B1                9140 *    * AUTHOR'S OPERATING SYSTEM/MONITOR
08B1                9150 *
08B1                9160 PRTFLG EQU  363035
08B1                9170 BUFEND EQU  360317
08B1                9180 BFNDST EQU  357322
08B1                9190 PBUF   EQU  360157
08B1                9200 ERASE  EQU  343243
08B1                9210 LPRTR  EQU  357260
08B1                9220 *
08B1                9999 * END OF PRINT ROUTINE
NO ERRORS FOUND

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READY
LTABL
B1      0816   B2      0818   B3      081A   B4      082E
B5      0830   B6      0832   B7      0846   B8      0848
B9      084A   BEGIN   0017   BEGIN1  0022   BFNDST  EFD2
BKLT    06E9   BKRT    0663   BUFEND  F0CF   D1      084C
D2      084E   D3      0850   D4      0852   D5      0854
D6      0856   D7      0858   D8      085A   D9      085C
DISPLY  00C4   DNLT    02B9   DNRT    0233   EDITOR  E388
ERASE   E3A3   F1      080A   F2      080C   F3      080E
F4      0822   F5      0824   F6      0826   F7      083A
F8      083C   F9      083E   FORMOT  08AC   FRLT    05DD
FRRT    0557   GETCMD  00CA   INIT    0028   KEYIN   E36A
L1      0804   L2      0806   L3      0808   L4      081C
L5      081E   L6      0820   L7      0834   L8      0836
L9      0838   LPRTR   EFB0   LTLT    03C5   LTRT    033F
MONITR  E000   MOVES   077F   PBUF    F06F   PRINT   088A
PRTFLG  F31D   R1      0810   R2      0812   R3      0814
R4      0828   R5      082A   R6      082C   R7      0840
R8      0842   R9      0844   RTLT    04D1   RTRT    044B
SCREEN  076F   STACK   086A   STAK    088A   START   0000
TRMOUT  F370   U1      07F2   U2      07F4   U3      07F6
U4      07F8   U5      07FA   U6      07FC   U7      07FE
U8      0800   U9      0802   UPDATE  0118   UPLT    01AD
UPRT    0127
CUBE  3000  6BDF
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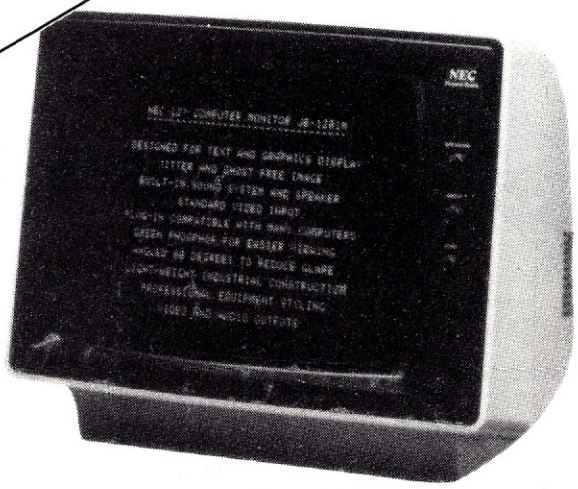

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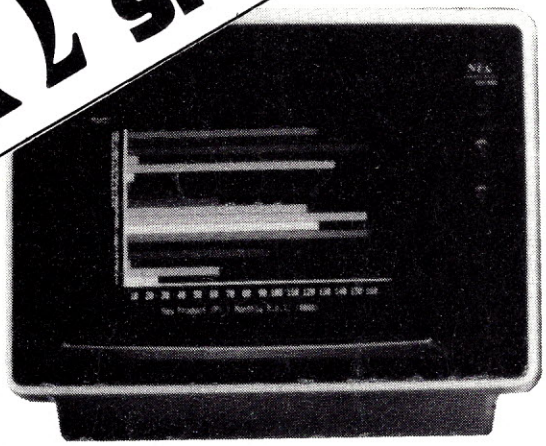

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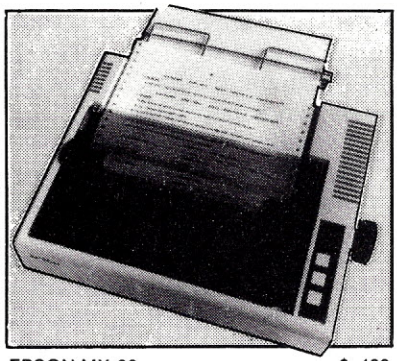

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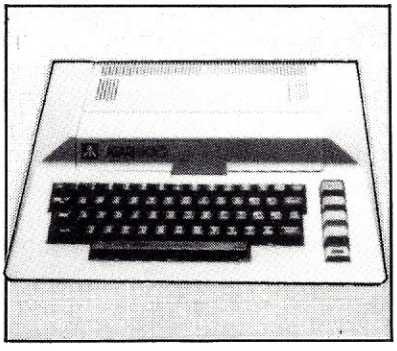

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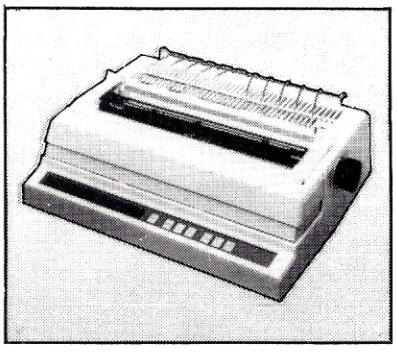

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Editor's Corner

Micros in Science

By Harry Nelson
Microcomputing Technical Editor

Micros Practice Science

The sciences—human, social, biological and physical—have all required frequent and often very complex mathematical calculations. It is hardly surprising that scientists and students of science have sought better and better aids for performing calculations that are extremely repetitious, almost incomprehensibly complicated or simply very lengthy. Some early thinkers developed crude mechanical calculating devices. The trusty old slide rule was indispensable in situations that did not require more than a few decimal places of accuracy. Mainframe and then minicomputers have been a very expensive solution. Small calculators were much more accurate than the slide rules but could not handle or store data as the computers could.

The result was that large projects with very large budgets got their own computers. Smaller projects, labs, and science education facilities got access to time-sharing systems—when they were lucky. Even those that did have access to a large system were often not lucky. Sometimes access was restricted to unusual hours, and if the system went down the only options were to just wait or do the work by hand.

It didn't take scientists long to realize that the computer could do more for them then just serve as a high-powered and expensive calculator. Computer models could be designed to simulate a variety of situations scientists wanted to study. And this could be done interactively with the researcher changing parameters of the situation being investigated to observe possible results. Computers could also be programmed to control experiments and record and analyze data from them. Again, as long as a project could maintain its own computer, there was little problem. But time-sharing presented more difficulties in these applications than in strict calculating operations.

Within the past few years many scientists have been discovering a powerful new tool that can be used in a variety of ways in their research. The microcomputer, used in conjunction with a larger system or as a stand-alone system, has started to emerge as a valuable tool for many scientific applications.

Sidney Fernbach, deputy associate director for scientific support at the Lawrence Livermore Laboratory, is a more than credible witness to this tendency (see "Scientific Use of Computers" in *The Computer Age: A Twenty-Year View,* edited by Michael L. Dertouzous and Joel Moses, The MIT Press, Cambridge, MA, 1979, p. 146). He says, "While the scientific community has been the user of most of the large computers built, interestingly enough, it also uses most of the minicomputers (and now microcomputers). . . .There is no doubt that the minicomputer will continue to be used heavily in the scientific laboratory. . . (but) growing availability and improving performance of microprocessors may change this somewhat . . . .It seems clear that every experiment will have one or more processors tied to it for control, data acquisition and data analysis purposes. . . . Soon we will find the microprocessors far outnumber the minis."

Expanding on scientific networks, Fernbach writes, "What I picture is networks made up of computers of all varieties. These can be local networks or local networks tied to any number of remote systems. In each there will be a set of functional boxes or computers dedicated to specific functions. One or more may do nothing but print, another plot, another create pictures on film, another retrieve information from a local data bank. In other words, instead of a large-scale general purpose computer, I visualize a distributed system in which specific jobs are parceled out to specialists."

Fernbach's vision of only two years ago is reality today. There are a number of small (and I might add inexpensive) microcomputers available that are ideal, and in some cases have been designed for such dedicated single-functions jobs as equipment control and data acquisition. (See, for example, "Everyman's Computer System" by J. McKown and S. Sarns, *Microcomputing,* Dec. 1981, p. 32.)

Distributed intelligence networks are becoming almost commonplace. They are appearing in business offices as well as scientific laboratories (not to mention the Children's Television Workshop's Sesame Place). (See "(Distributed) Intelligence Networks in the Office" by Michael Brandt and Michael Bodner, *Microcomputing,* Oct. 1981, p. 80.)

Personal microcomputers are being used by many scientists today. One very interesting example involves some recent discoveries in "experimental" mathematics (that's right, there is such a thing as empirical mathematics and discoveries is the correct word to use for findings in that area). M. J. Feigenbaum of the Los Alamos National Laboratory has found some important characteristics of the phenomena known as *strange attractors* that occur in a variety of systems of interest to scientists ranging from meteorologists to physicists. (For an engaging introduction to this

fascinating topic see Douglas Hofstader's "Metamagical Themas" column in the Nov. 1981 *Scientific American*, p. 22.) One thing that is striking about Feigenbaum's work, in the present context, is that some of his very important discoveries were made with the aid of a small computer and a calculator.

(The mention of meteorologists calls a recent news item to mind. The National Weather Service is in the process of installing a large national minicomputer-based system. But in the meantime, directors of some weather service centers have decided to purchase and use Zenith Z-89 microcomputers with modems rather than wait for completion of the large system.)

The science-related articles that follow, in addition to describing specific uses of microcomputers, indicate something of the flexibility and range of possible science applications. Obviously, we could not hope to cover the entire spectrum in a single issue. So, from time to time we will be printing more material on uses of micros in the sciences.

It also seems worth noting that new products are beginning to appear that facilitate the use of off-the-shelf microcomputers in the science lab. One such product, called Isaac (Cyborg Corp., Boston, MA), allows you to use an Apple for instrument control, data acquisition, electronic testing and process control. The manufacturer claims it can be easily used for applications in chemistry, engineering, psychology and physiology. It sounds like it turns a standard Apple into a versatile laboratory machine.

Cubist's Corner

Rubik's Cube has become so popular that its devotees have their own fashionable malady. Cubist's thumb has definitely replaced tennis elbow. So, in an endeavor to preserve the national health we have offered two cube simulation programs (one for the Apple and one for Z-80 systems) in this issue. But both programs only offer one mode of what we feel should be included in a *complete* cube program. The Coopers' and Paul Turvill's programs allow you to input a desired number of twists, which the computer then makes; then it is up to you to restore the cube. That's a fine first step. In fact, it is just like working with an actual Rubik's Cube. The next step would be to include a second mode in which you would mix up the cube and the computer would restore it. Such programs do exist—I have seen a few excellent ones for large computers and heard of a few for micros. In fact, we are in the process of reviewing a few for possible publication and would be interested in seeing more.

Micros and Minis

Last spring a somewhat unsettling situation came to my attention. A friend who had just earned his degree in computer science from a large state university and I were talking about job prospects in the computer field. He was concerned because, in spite of a good academic record, he was having some difficulty in finding a good position. He said that he was interested in gaining some programming experience and was especially interested in working with Pascal.

I couldn't understand why he was having any trouble at all finding a good job. We are constantly hearing about the need for good programmers. I asked what companies he had been talking to. He named several of the large minicomputer manufacturers and several companies that offer software support services for the products of these manufacturers. When I asked what microcomputer companies and software houses he had contacted, his answer astonished me, especially in light of the fact that he wanted to locate in the San Francisco area. He hadn't been in contact with any.

As we talked it became apparent that he was equating microcomputers with video games. He didn't think of micros as real computers. And worst of all he was completely unaware of the extremely large and rapidly growing microcomputer industry. He simply did not know it existed. It was disturbing to find that a good student could complete four years in a respected computer science program and never be made aware of one of the most dynamic segments of the computer industry. After doing some checking I found that my young friend's situation was not uncommon. I also learned of several educational institutions that do incorporate microcomputing into their programs. These schools are working to give their students a full picture of the field for which their graduates are being prepared. But there are still a number of highly respected schools that are not offering their students a complete preparation for their chosen field.

Several possible reasons for this exist, but two of them seem to stand out. The microcomputer field, as we all know but sometimes forget, is very new—by most accounts only about six years old. As a significant industry, microcomputing is even newer. And most computer science professors were trained during, or were part of, the minicomputer revolution. Then too, educational institutions are not always noted for their ability to rapidly change with the times, despite the best efforts of some of the faculty. (We have to sympathize with those who must try to convince an administration that is still paying for a large time-sharing system to go out and buy a significant number of new machines—but we have learned of some very creative strategies used by some individuals and departments to get around this obstacle for the benefit of their students.)

It still bothered me that a number of young computer professionals would have to gain their first microcomputing experience as on-the-job training. Feeling, however, that the computer-educational establishment was at least starting to move in the proper direction, I more or less put the mini/micro question out of my mind. But a recent article in a computer publication (see "Mini or Micro: Which Way to Go?" by John Seaman in *Computer Decisions*, Oct. 1981, p. 90) raised the question anew in a slightly different context. Here the question was posed in the context of which kind of system was most appropriate for business purposes. (It may be a bit unfair to single out Seaman's article, because one can find numerous articles containing some of the same information and I believe Seaman was trying to be objective. The information he was dealing with, however, made that impossible.)

The criteria for comparison in this article are:

- speed of operation
- response time
- amount of memory
- control of a variety of peripherals
- hardware and software availability
- service

(continued on page 93)

This Apple program helps scientists gather data and analyze geologic research.

Uncovering the History Of the Earth

By Fred J. Gunther

Computers have contributed to important changes in the way scientists do science. Some advances, such as those in space research, are enormous and obvious; others are not. But the way data is collected, organized and analyzed has unquestionably changed in all branches of science, and microcomputers are the newest part of that change.

Most geologists are not mathematically or computer oriented. They are interested in the Earth, its rocks and minerals, its parade of plant and animal life through geologic time, its mountains and what caused them and its oceans and continents.

Even geologic research has changed because of the use of computers. Earthquake data is recorded with much greater sensitivity. Indications of ore deposits can be detected in computer-processed images taken by satellites. Several technical journals publish articles by mathematical geologists concerning fossils, magnetism, ore deposits, storm waves and statistical tests. Data of all types can be processed much more efficiently and accurately.

When I was a graduate student, my first job as a laboratory assistant was to help a senior graduate student with his research. I was to take his hand-calculated results for species percent data at each of many oceanographic collection stations and calculate an index of similarity for each and every pair of stations. The resulting numbers would enable the senior graduate student to draw a map of the ocean floor showing which stations had similar collections of animals. There were many stations, and many species, and it took weeks to calculate the matrix.

That same semester, I took a course in FORTRAN IV computer programming on a CDC-3300 (a big computer in 1967). By the time I was a senior graduate student, I had designed, written and debugged a computer

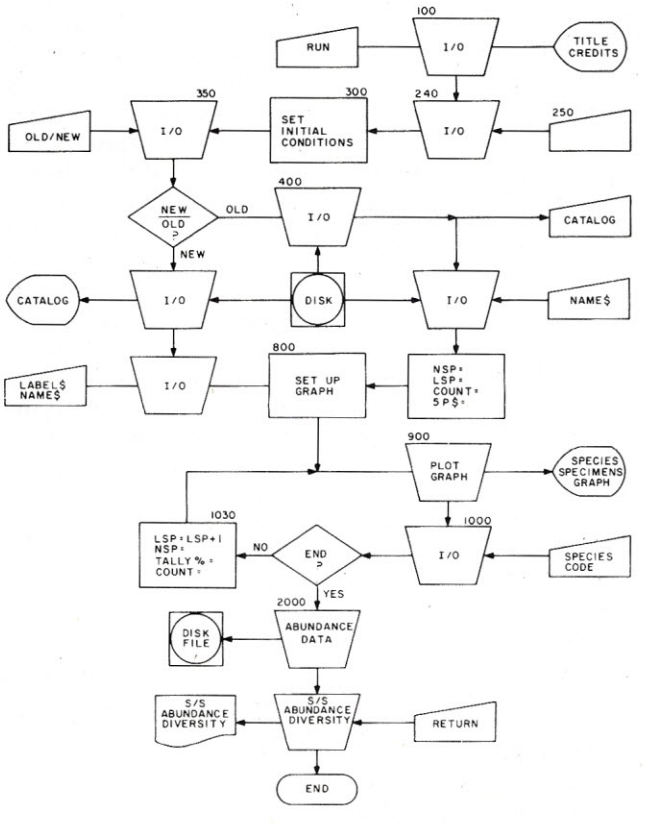

Fig. 1. Flowchart for the PEG Helper program.

Address correspondence to Dr. Fred J. Gunther, 9464 Wandering Way, Columbia, MD 21045.

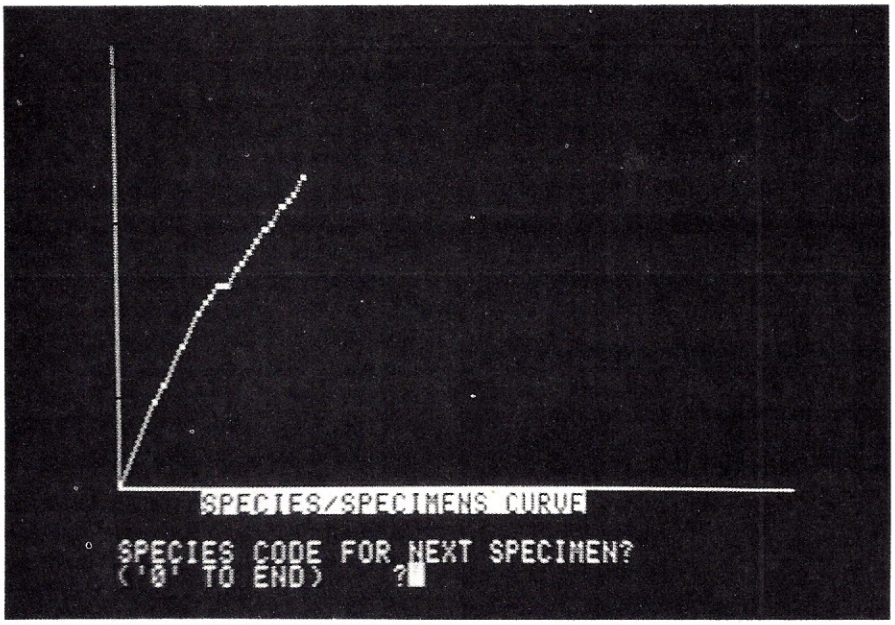

Photo 1. Monitor display of Example Species/Specimens curve. The steepness of the curve indicates that new species are still being found at a rapid rate. For this reason many more specimens need to be examined to adequately know what the species composition of the sample is.

program that calculated the same index of similarity for all station pairs in a few seconds. In addition, it produced all of the other previously hand-calculated values for species abundance. And it calculated many other "nifty numbers" of use and interest to geologists and marine biologists.

Input Problems

To use my program, I still had to examine the samples, keep a tally of the number of specimens for each sample and keypunch the data onto computer cards.

Many other scientists face the same problems in data entry. Marine biologists often count the numbers of individuals for each species of plant or animal. Ecologists often pay close attention to both the type and the number of specimens for each species. Many scientific studies depend upon being able to tally the number of specimens for each species. The frequency distributions of species in each sample can be compared by eye or by computer program to indicate what the natural communities or groups of species are.

Some solutions to the data-entry problem have been suggested. The counted number of specimens can be entered onto a machine-readable form. The sense-marked form or card can then be read by a computer in essentially the same way as for machine grading of multiple-choice examinations.

Data entry directly from sample material has been performed using large computers for automatic shape analysis, but only for special cases in medicine and genetics. Recently a microprocessor-based texture analysis station for cell and tissue samples, featuring direct data entry, has been advertised.

Fossils, however, must be identified by eye. Direct-entry computer systems cannot handle the variety in shapes and orientation encountered in the species-analysis of paleontologic, ecologic or geologic samples. Fossil specimens must be found, separated from the surrounding rock, cleaned, examined and finally identified and tallied by species.

I decided to use an Apple microcomputer to keep the tally for each species in a sample. The program presented here (Listing 1) allows the Apple to assist the scientist or technician in data collection and preliminary analysis. It's named the PEG Helper because I use it for research in

SP$(100)	The array of species ID codes. A string variable is used so that numbers and/or letters can form the ID code. Thus 33 is as valid as T33, and both are as valid as the full scientific name, *Textularia earlandi*. Be careful of spelling errors on input; each spelling variation is treated as a different species ID code.
COUNT(100)	The array of the counted number of specimens for each species. It is updated every time a new specimen ID code is entered.
TALLY%(1000)	The array for the number of species known at the time that each specimen was found. It is updated every time a new specimen ID code is entered.
NSP	The total number of species. It is updated each time a new species is entered.
LSP	The total number of specimens. It is updated every time a specimen ID code is entered.
LABEL$	A string variable with sample and project identification information. It is typed in by the analyst at the start of an analysis. It is stored on the disk to be read when an analysis is continued after an interruption.
NAME$	A string variable for the name of the data file. It is used for disk storage and must be unique.

Table 1. Important variables for PEG Microscope Helper program.

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Paleontology, Ecology and Geology. All I have to do is type in a code name or number each time I see a specimen. The computer does all the rest of the data entry, record-keeping and calculations. The program helps me to "work smart, not hard."

Bells and Whistles

Of course, once the data is in machine-readable form, other things can be done (Fig. 1). The program does much more than simply replace a tally sheet or a multi-key counter. A variety of important reports are produced from the data.

The program calculates the relative (percent) abundance of each species and prints this along with the tally and species ID code. (Sample 1.)

A graph showing the frequency of occurrence of new species as additional specimens are studied is a very useful report. Where the curve is steep, the analyst can expect to find more species as more specimens are examined. Where the curve is very flat, the analyst can expect that the examination of additional specimens is unlikely to produce additional species. The curve therefore can be used to predict the results of additional work to analyze the sample. If the curve is very flat, the cost of finding new species may be considered to be too high, and the analyst can stop.

A manual tally of the number of specimens vs the number of species is very difficult to keep. I've done it many times and know the problems involved well. The program instructions allow the computer to keep the tally and to generate a continuously-updated plot for every single sample, at no extra effort to the analyst (Photo 1).

Species diversity is one of those "nifty numbers" mentioned earlier. It is of interest to specialists in the studies of modern and ancient groups of animals or plants. It attempts to measure one aspect of population or group organization. Changes in diversity have been related to changes in the environment in many scientific studies; it is common knowledge that there are fewer species and in-

Sample 1. Printer copy of Species Abundance matrix. This is the data that would have to be tallied by hand and entered to a computer by punched cards if this program did not exist. This data is stored on a disk file for direct entry to computer programs that will do additional analyses.

SPECIMEN COUNT	SAMPLE PERCENT	SPECIES ID CODE
1	1.28205128	28
2	2.56410256	70
2	2.56410256	43
2	2.56410256	67
1	1.28205128	30
1	1.28205128	24
1	1.28205128	68
1	1.28205128	4
1	1.28205128	49
2	2.56410256	27
1	1.28205128	74
1	1.28205128	75
1	1.28205128	61
2	2.56410256	8
5	6.41025641	69
2	2.56410256	25
2	2.56410256	13
3	3.84615385	39
2	2.56410256	5
1	1.28205128	16
2	2.56410256	7
1	1.28205128	35
1	1.28205128	99
3	3.84615385	79
2	2.56410256	47
1	1.28205128	97
2	2.56410256	73
1	1.28205128	40
2	2.56410256	57
1	1.28205128	22
1	1.28205128	62
2	2.56410256	42
1	1.28205128	2
1	1.28205128	58
1	1.28205128	96
1	1.28205128	17
1	1.28205128	84
1	1.28205128	98
1	1.28205128	82
2	2.56410256	26
1	1.28205128	52
1	1.28205128	41
1	1.28205128	54
1	1.28205128	3
1	1.28205128	44
2	2.56410256	72
1	1.28205128	37
1	1.28205128	86
1	1.28205128	59
1	1.28205128	92
1	1.28205128	23
1	1.28205128	50
1	1.28205128	89
1	1.28205128	29
1	1.28205128	32

```
                DIVERSITY INDICES

55 = NUMBER OF SPECIES

12.3946773 = MARGALEF'S INDEX

.976988823 = SIMPSON'S INDEX

-10.8321596 = MC INTOSH'S INDEX

1.6948065 = SHANNON'S INDEX    (INFORMATION THEORY)


                REFERENCES

MAC ARTHUR 1965 BIOL.REVIEW 40:511-533
MC INTOSH 1967 ECOLOGY 48(3): 392-404
SANDERS 1968 AMERICAN NATURALIST 102(925): 243-282
```

Sample 2. Printer copy of diversity data.

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dividuals in Arctic regions than in tropical regions.

Many scientists have calculated the species diversity of the samples that they study. Of course, where there are many people, there are many different opinions. There are several opinions on how to measure the diversity of a sample, and so there are several algorithms. Each tries to answer the question, "Is this sample really different from that sample?"

The Helper program helps out in this case also. It calculates and prints several indices of diversity. The printer copy (Sample 1) with the different diversity values becomes part of the analysis file for the sample and project.

Program Code

The program code has three major sections (see Fig. 1). The program first prints a title page and asks the user for information (Photo 2); it then sets up the initial conditions for that run (Listing 1, lines 90 to 950). Second, the program requests input for each species, and then processes the data (Listing 1, lines 900 to 1090—yes, lines 900 to 950 are used by both setup and run portions of the program). Finally, when the input sequence is complete, the program writes the data onto a disk file (Listing 1, lines 2000 to 2170), and prints (lines 3000 to 5430) a hard copy of the results (Fig. 2 and Sample 1; also Sample 2). The program is so dependent upon user input for pacing that it is coded in linear (non-optimized) form (see Fig. 1 and Listing 1).

Program Use

I have already written a lot about how the program is used. However,

Listing 1. PEG Microscope Helper, written in Applesoft BASIC to take advantage of high-resolution graphics to display the species/specimens curve.

```
90  CLEAR
100  HOME : PRINT "       P E G      MICROSCOPE HELPER"
110  PRINT : INVERSE : PRINT "P",: NORMAL : PRINT "PALEONTOLOGY"
120  INVERSE : PRINT "E",: NORMAL : PRINT "ECOLOGY"
130  INVERSE : PRINT "G",: NORMAL : PRINT "GEOLOGY"
140  PRINT : PRINT : INVERSE : PRINT "DR. FRED J. GUNTHER"
150  PRINT "9464 WANDERING WAY": PRINT "COLUMBIA MD 21045"
160  NORMAL : PRINT : PRINT : PRINT "INPUT IS ID CODE FOR EACH SPECIMEN"
170  PRINT : PRINT : PRINT "OUTPUT IS:"
180  LET MM$ = "SPECIES/SPECIMENS CURVE"
190  PRINT "  -1- HGR";MM$
200  PRINT "  -2- DISK COPY, SPECIES TALLY"
210  PRINT "  -3- PRINTED ";MM$
220  PRINT "  -4- PRINTED SPECIES TALLY"
230  PRINT "  -5- PRINTED SPECIES DIVERSITY": PRINT : PRINT
240  LET M$ = "ADJUST PRINTER AND (RETURN)"
250  PRINT M$: INPUT "SLOT NUMBER FOR PRINTER ";N
260  PRINT : INPUT "SPECIAL PRINTER CONTROL CHARACTERS. ";CC$
300  HOME : REM  SET INITIAL CONDITIONS
310  VTAB 10
320  DIM SP$(100),COUNT(100): REM  UP TO 100 SPECIES
330  DIM TALLY%(1000): REM  UP TO 1000 SPECIMENS
340  LET NSP = 0:LSP = 0
350  INPUT "NEW SAMPLE OR CONTINUATION OF OLD?       (NEW/OLD) ";IN$
360  IF IN$ = "NEW" THEN  GOTO 600
370  IF IN$ = "OLD" THEN  GOTO 400
380  PRINT : INVERSE : PRINT "UNEXPECTED RESPONSE"
390  NORMAL : PRINT : GOTO 350
400  HOME : PRINT "WHICH FILE? ('0' IF NOT HERE)"
410  PRINT : PRINT  CHR$ (4);" CATALOG"
420  PRINT : INPUT NAME$
430  IF NAME$ = "0" THEN  PRINT "INSERT NEW DISK": GOTO 350
440  PRINT  CHR$ (4);" OPEN ";NAME$
450  PRINT  CHR$ (4);" READ ";NAME$
460  INPUT LABEL$: INPUT NSP: INPUT LSP
470  FOR J = 1 TO NSP: INPUT COUNT(J)
480  INPUT SP$(J): NEXT J
490  PRINT  CHR$ (4);" CLOSE ";NAME$
500  GOTO 800
600  PRINT "TYPE IN LABEL FOR THIS SAMPLE."
620  PRINT : INPUT LABEL$: PRINT : PRINT
630  PRINT "IS THIS THE DISK YOU WANT TO STORE THE"
640  PRINT "DATA ON?": PRINT  CHR$ (4),"CATALOG"
650  INPUT "(YES/NO)";IN$: IF IN$ = "YES" THEN  GOTO 670
660  INPUT "PUT PROPER DISK IN DRIVE AND (RETURN)";IN$: GOTO 630
670  PRINT : INPUT "GIVE FILE NAME (DO NOT USE ONE OF THE ABOVE).";NAME$
800  REM  SETUP HGR GRAPH
810  HOME : VTAB 21: HGR : HCOLOR= 3
820  HPLOT 0,0 TO 0,159 TO 279,159
830  PRINT ".....";: INVERSE : PRINT MM$
840  NORMAL : POKE 34,23: VTAB 23
900  LET Y = 159 - 2 * NSP
910  IF Y < 0 THEN  GOTO 1000
```

some details might be useful to you to see if you could use it in your applications.

The program has been used in a computer with the keyboard next to a microscope (for small fossils) or specimen-sorting tray (for large fossils) in a laboratory. The computer must be connected to a monitor, a disk drive and a printer.

The analyst first enters general sample information, starting a new file or continuing an old one as appropriate. S/he spreads the sample thinly over the surface of a small tray and carefully searches it for specimens. Usually, there are many grains of sand and few specimens. As each specimen is encountered, the analyst identifies it and types a short code name or number on the keyboard. A specimen that is new to the project must be given a new code ID and set

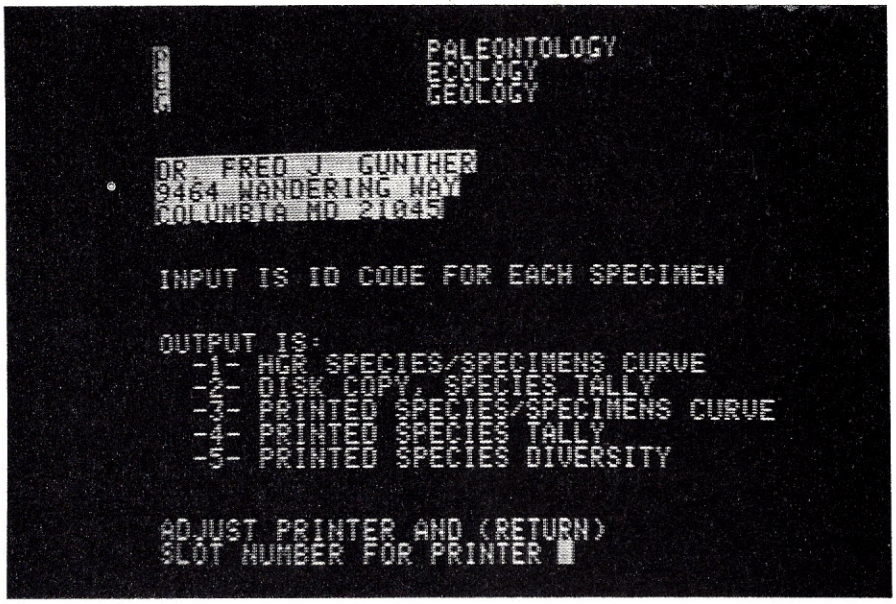

Photo 2. Monitor display of program title page. The prompt at the bottom of the page allows the program to be run on systems with different configurations.

```
920  LET J = LSP
930  IF J > 280 THEN  LET J = J - 280: GOTO 930
950  HPLOT J,Y TO J,Y + 1
1000  PRINT "SPECIES CODE FOR NEXT SPECIMEN?"
1010  PRINT "('0' TO END)",
1020  INPUT IN$: IF IN$ = "0" THEN  TEXT : POKE 34,0: GOTO 2000
1030  LET LSP = LSP + 1
1035  FOR J = 1 TO NSP:JJ = J
1040  IF IN$ = SP$(J) THEN  GOTO 1070
1050  NEXT J:NSP = NSP + 1: REM  ADD NEW SPECIES
1060  LET SP$(NSP) = IN$:JJ = NSP: REM  STORE NEW SPECIES WORKING CODE
1070  LET TALLY%(LSP) = NSP
1080  LET COUNT(JJ) = COUNT(JJ) + 1: REM  UPDATE SPECIES ABUNDANCE MATRIX
1090  GOTO 900
2000  PRINT "WRITE DATA TO DISK FILE."
2110  PRINT  CHR$ (4);"OPEN";NAME$: REM  WRITE DATA TO DISK
2120  PRINT  CHR$ (4);"WRITE";NAME$
2130  PRINT LABEL$: REM  KEEP ID WITH FILE
2140  PRINT NSP: REM  NUMBER OF SPECIES
2150  PRINT LSP: REM  NUMBER OF SPECIMENS
2160  FOR J = 1 TO NSP: PRINT COUNT(J): PRINT SP$(J): NEXT
2170  PRINT  CHR$ (4);"CLOSE";NAME$
3000  TEXT : FLASH : PRINT M$: INPUT IN$: NORMAL
3110  PR# N: PRINT CC$: PRINT LABEL$: PRINT : PRINT : PRINT MM$: PRINT
3120  PRINT ,"0";: FOR J = 10 TO 100 STEP 10: PRINT "       ";J;: NEXT J: PRINT
3130  PRINT ,"*";: FOR J = 1 TO 10: PRINT "----I----*";: NEXT : PRINT
3140  FOR J = 1 TO LSP: PRINT J,"*";: REM        PRINT A LINE
3150  IF TALLY%(J) = 1 THEN  PRINT "#": GOTO 3170
3160  FOR JJ = 2 TO TALLY%(J): PRINT " ";: NEXT JJ: PRINT "#"
3170  NEXT J
4000  FOR J = 1 TO 5: PRINT : NEXT : REM  ABUNDANCE DATA
4100  PR# 0: PRINT M$: INPUT IN$
4110  PR# N: PRINT CC$: PRINT LABEL$: PRINT : PRINT
4120  PRINT "SPECIMEN","SAMPLE",SPECIES":PRINT "COUNT","PERCENT","IDCODE"
4130  FOR J = 1 TO NS: PRINT COUNT(J),100 * COUNT(J) / LSP,SP$(J): PRINT : NEXT
5000  PR# 0: PRINT M$: INPUT IN$
5010  PR# N: PRINT CC$: PRINT LABEL$: PRINT : PRINT
5020  PRINT "","DIVERSITY INDICES": PRINT : PRINT
5030  LET SSQ = 0:PSQ = 0:PLG = 0
5040  PRINT NSP;"=NUMBER OF SPECIES"
5100  FOR J = 1 TO NSP: LET P = COUND(J) / LSP
5110  LET SSQ = SSQ + COUNT(J) ^ 2
5120  LET PSQ = PSQ + P ^ 2
5130  LET PLG = PLG + P *  LOG (P) * 0.4342945
5140  NEXT J
5200  LET DM = (NSP - 1) /  LOG (LSP)
5210  LET DH =  - 1 * PLG
5220  LET DD = 1 -  SQR (SSQ):DP = 1 - PSQ
5300  PRINT : PRINT : PRINT DM;"=MARGALEF'S INDEX"
5310  PRINT : PRINT : PRINT DP;"=SIMPSON'S INDEX"
5320  PRINT : PRINT : PRINT DD;"=MCINTOSH'S INDEX"
5340  PRINT : PRINT : PRINT DH;"=SHANNON'S INDEX (INFORMATION THEORY"
5400  PRINT : PRINT : PRINT : PRINT "","REFERENCES": PRINT
5410  PRINT "MACARTHUR 1965 BIOL. REVIEW 40:511-533"
5420  PRINT "MCINTOSH 1967 ECOLOGY 48(3): 392-404"
5430  PRINT "SANDERS 1968 AMERICAN NATURALIST 102(925): 243-282"
6000  PR# 0: POKE 34,0: END
```

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aside for later identification; specimens of recognized species need not be set aside.

All records are kept by the computer. It is not necessary for the analyst to write down anything, other than the ID code for each set-aside specimen. The computer keeps all data up-to-date on internal files. It also plots in real time the species/specimens curve. At the end of the analysis, the computer prints disk copies of some files and hard copies of all files.

Because the analysis of a sample may take a long time, the program has the capability of reading a disk file. This allows the analyst to take a break (for coffee, lunch, or the end of the working day) after recording the data up to that time. The analyst can continue from that point after the program has read the stored data from the disk file. The computer printout for that sample will be in two or more parts, but that problem can be solved with scissors and tape.

The program should be useful not only to paleontologists (geologists who work with plant and animal fossils), but also to many other scientists and to anyone interested in the numbers of species of plants or animals found in one place. Even those who work with inorganic items, such as geologists who study sand grains, could find this program useful in collecting data about the "species" of heavy minerals. It might even be useful to a traffic analyst, who must count the numbers of different types of vehicles that pass a certain point of a road. It could assist in keeping track of the numbers and species of birds that visit a bird feeder, or the animals that visit a salt lick or a water hole. Let me know what uses you have found for the program.■

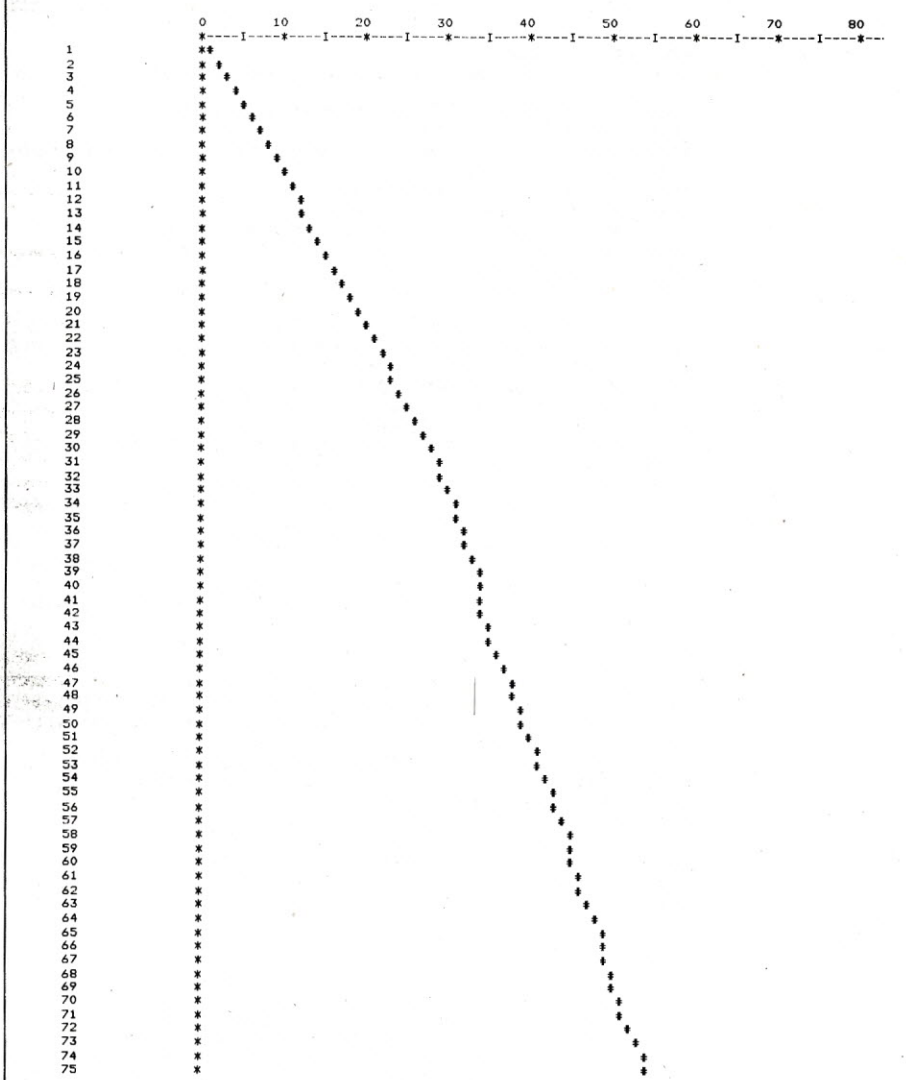

Fig. 2. Printer copy of Example Species/Specimens curve. The number of species is printed horizontally and the number of specimens vertically. Each specimen is represented by a line; if a specimen is of a new species, a new column is added. This is the same curve shown in Photo 1, but this curve is produced using a different medium with a different aspect ratio to the plot.

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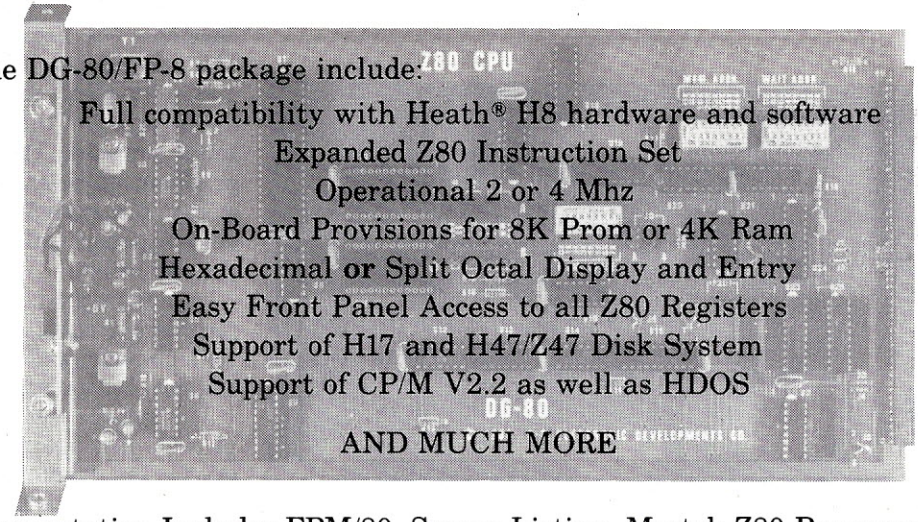

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When the going gets hot in the laboratory, the Apple is a versatile low-cost instrument to record graphic data.

Red Hot Computing

By Paul T. Ward

Many laboratory phenomena require recording a rapidly changing dc voltage for later analysis. In my laboratory, I routinely measure the output of photomultiplier tubes, recording the glow of irradiated phosphors as they are heated. During the heating process, the phosphors give off varying amounts of light, depending on the type of radiation and the temperature.

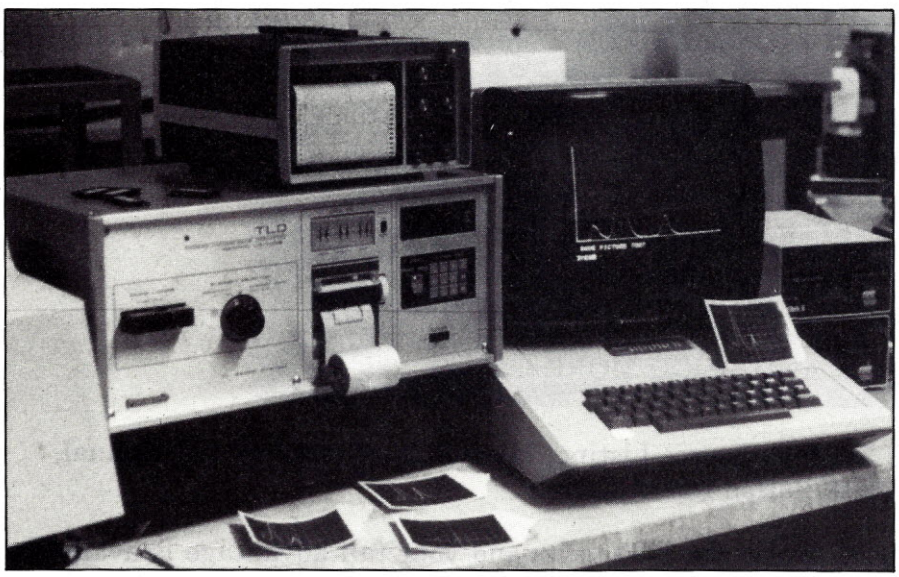
In the past, this glow curve has been recorded on a fast chart recorder. This became less accurate as we increased the heating rate, due to the starting inertia of the paper and pen.

The next step was to use an oscilloscope with a Polaroid camera to eliminate the mechanical time lags. This works, but it is less than ideal due to the high cost, the small size of the picture and the tricky synchronization problem. The synchronization problem can be solved with a special storage screen oscilloscope, but this is very expensive and tends to smear the recording.

I needed a good, low-cost method of recording graphic data that's too fast for a conventional chart recorder and too slow for a normal oscilloscope.

The answer was to bring in my Apple II microcomputer and hook it up to the photometer in the lab through an analog-to-digital (A/D) converter. I used an Interactive Structures AI-02 converter, which is an eight-bit, 16-channel model. This device accepts dc voltages from 0–5 V, and digitizes this into a number from 0–255.

The digitization is started by poking a base address (which depends on the slot number of the converter) with the number of the A/D channel



From left to right, IDS-440 Paper Tiger printer, Panasonic model UD702 thermoluminescent dosimeter reader, Apple II+, chart recorder and Tektronix oscilloscope with Polaroid camera attached.

Program listing.

```
10  REM  A/D CONVERTER PROGRAM FOR
20  REM  INTERACTIVE STRUCTURE
30  REM  MODEL AI-02 ANLG-DGTL CONVTR
40  REM  A=BASE ADDRESS
50  REM  AP1=CONVERSION RESULT ADDRESS
60  REM  CH=CHANNEL # OF A/D CONVERTER
70  REM  V(I)= RESULT OF CONVRSN I
75  REM  P(I)= V(I) * SCALE FACTOR TO PLOT ON HI-RES PAGE ONE
80  REM
82  D$ =  CHR$ (4)
```

More

Address correspondence to Paul T. Ward, Radiological Health program, School of Public Health, The University of Michigan, Ann Arbor, MI 48109.

connected. You get the result of the conversion by peeking at an address one byte higher than the base address.

By using the Program listing, I obtained a plot of the digitized data just like one from our storage screen oscilloscope running at 1 cm/sec. The data was plotted in high-resolution graphics as it was generated. If you need faster sampling rates, the plotting could be done later, since the values are stored in the V array.

An option at the end of the program stores the data as numbers, a high-resolution picture or both. To restore the picture to the screen, first BLOAD the file it was saved in, then enter

GR:POKE -16297,0

to restore the high-resolution screen. The screen image can be hard-copied on a dot-matrix printer with a graphics driver program. A short BASIC program is required to read the number data from the disk file.

Similarly, you can make a fast X-Y recorder by plotting one conversion against the other, recording from two A/D channels alternately. This technique is useful for examining the hysteresis loop of control systems too fast for conventional X-Y recorders.■

Listing continued.

```
85  DIM Q$(5),NM$(15)
90  DIM V(280),P(280)
95  HGR : TEXT
100 A =  - 14592: REM  SLOT #7 ADDRESS
110 AP1 = A + 1
120 CH = 0: REM   CHANNEL ZERO
130  CALL  - 936: VTAB 10: PRINT "THIS PROGRAM READS A D.C. VOLTAGE FROM
    "
140  PRINT : PRINT "0 TO +5.0 VDC USING AN INTERACTIVE"
150  PRINT : PRINT "STRUCTURES MODEL AI-02 A/D CONVERTER"
160  REM  START CONVERSION
170  VTAB 23: PRINT " PRESS ANY KEY TO CONTINUE"
180  IF  PEEK ( - 16384) > 127 THEN  GOTO 200
190  GOTO 180
200  CALL  - 936: VTAB 23: PRINT " RECORDING DATA "
210  HGR : HCOLOR= 3: HPLOT 0,0 TO 0,159: HPLOT 0,159 TO 279,159
220  FOR I = 0 TO 279
230  POKE AP1,CH
240 V(I) =  PEEK (A)
250 P(I) = V(I) * 0.623: REM   SCALE DATA TO FIT HI-RES PAGE ONE
260  HPLOT I,(159 - P(I))
270  NEXT I
280  CALL  - 936: VTAB 23: PRINT " RECORDING FINISHED "
290  PRINT : INPUT " SAVE THIS DATA? ";Q$
300  IF  LEFT$ (Q$,1) = "Y" THEN  GOTO 350
310  PRINT : INPUT " ANOTHER RUN? ";Q$
320  IF  LEFT$ (Q$,1) = "Y" THEN  GOTO 170
330  END
350  PRINT " WHAT FILENAME? (UP TO TEN CHARACTERS)": INPUT NM$
360  INPUT " SAVE PICTURE TOO? ";PC$
370  PRINT D$;"OPEN";NM$
375  PRINT D$;"WRITE";NM$
380  FOR K = 0 TO 279
390  PRINT V(K)
395  NEXT K
400  PRINT D$;"CLOSE";NM$
420  IF  LEFT$ (PC$,1) = "Y" THEN  GOTO 450
430  GOTO 310
450 NM$ = NM$ + ".PIC"
470  PRINT D$;"BSAVE ";NM$;",A$2000,L$2000"
490  GOTO 310
```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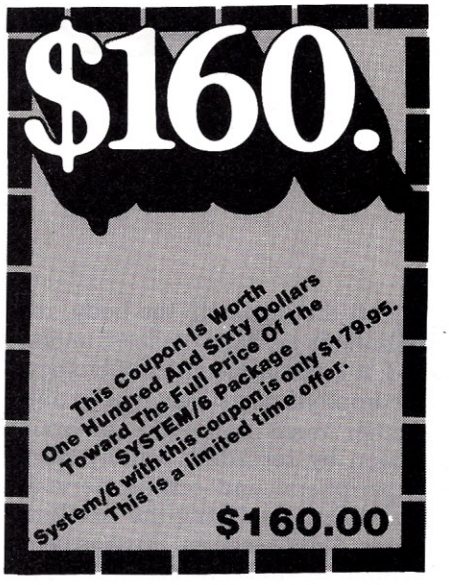

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This unique application for the H8 helps neurophysiologists crack the "last frontier of biology."

Tapping Into the Brain

By Robert M. Bradley

Of all the organs in the body, the brain is perhaps the least understood. It is the last frontier of biology.

Neurophysiologists have been able to gather much information on brain function by recording activity from the peripheral and central nervous systems and analyzing the resulting records. Until recently, this has been a tedious chore—investigators have had to rely on measurements from recordings photographed on a moving film passing across an oscilloscope screen. But the digital computer makes possible many types of analysis not possible before.

This interface for the Heath H8 measures the intervals between neural discharges and stores the data on disks for later study. It also stores in the data stream a marker to indicate the beginning and end of a stimulation. Once the interval data is stored, software can be used to convert intervals into frequency of impulses, and show the distribution pattern of the intervals with respect to time. The extent of the analysis is dependent primarily on the imagination and ingenuity of the researcher.

About Neurons

Neurophysiologists record electrical impulses produced by neurons. A neuron, the basic building block of the central nervous system, is made up of a cell body with cytoplasmic extensions called axons and dendrites. A neuron usually has only one axon, but can have a number of dendrites.

All information travelling in the central nervous system passes along the axons to the dendrites, where it crosses a synapse to the axon of the next neuron in the chain. Thus, neural activity typically begins at a sense organ and is transmitted along the neurons to the central nervous system, where the information is processed. This processing can result in a number of actions, the most obvious involving muscle use.

Neurophysiologists are particularly interested in the functioning of sensory receptors, specialized dendrites sensitive to physical states. A series of these receptors senses the external environment and translates the information into signals used by the central nervous system.

For example, the retina converts light energy into neural energy. The neural energy consists of action potentials (spikes, neural discharges) that are sent along the neurons to the central nervous system. These action potentials are a coded message of the transduced external energy.

To understand how the brain works, the researcher must tap into the neural messages and decipher the

Listing 1. Assembly-language listing of the program designed to run with the interface.

```
*INTERSPIKE INTERVAL PROGRAM-ISIP-
*
*AUTHOR: ROBERT M.BRADLEY
*        DEPT. ORAL BIOLOGY
*        SCHOOL OF DENTISTRY
*        UNIVERSITY OF MICHIGAN
*        ANN ARBOR
*        MICHIGAN, 48109.
*****************************************
*PULSE IS ON D0 PORT 004
*MARK BIT IS D1 PORT 004
*STOP BIT IS D2 PORT 004
*RESET IS PORT 006
*LSBYTE OF INT COUNT IS PORT 000
*MSBYTE OF INT COUNT IS PORT 002
*CLOCK IS SET AT 1MSEC
*MAXIMUM INTERVAL STORAGE 2KBYTES
        XTEXT   HDOS
START   ORG     USERFWA
MODE    EQU     223Q *SPECIFIES PORTS A & B OF 8255 AS INPUT PORTS,
CNTRL   EQU     003Q *AND PORT C AS 2 4 BIT PORTS, 1 AS INPUT 1 AS OUTPUT
DATA1   EQU     000Q    *LSBYTE OF COUNT PORT
DATA2   EQU     001Q    *MSBYTE OF COUNT PORT
DATA3   EQU     002Q    *PULSE MARK AND STOP BIT PORT
.OPENW  EQU     000043A *HDOS DEFINITIONS
.WRITE  EQU     000005A *  "       "
.CLOSE  EQU     000046A *  "       "
BEGIN   XRA     A
        MVI     B,001Q
        MVI     C,201Q
        SCALL   .CONSL  *SET UP TERM
        MVI     A,MODE  *SET UP 8255
        OUT     CNTRL   *  SETS UP TRANSFER CHARACTERISTICS
*
*     GET OUTPUT FILE NAME
```

More

Robert M. Bradley is on the faculty of the Department of Oral Biology, School of Dentistry, University of Michigan, Ann Arbor, MI 48109.

neural code. This is analogous to using a logic tester in a computer circuit.

To do this, he must isolate single neurons and record their action potentials, while stimulating the receptors to which they are connected. This is done either by dissecting the peripheral nerves to isolate single axons, or advancing an electrode with a very small uninsulated tip into the brain or other parts of the central nervous system. In either case, an active electrode picks up the electrical activity of the isolated neuron, while an indifferent electrode placed in nearby tissue completes the circuit.

The neural activity is amplified and recorded on magnetic tape. After the experiment, the tape is replayed and the data is analyzed.

The recordings consist of a series of action potentials that occur at various intervals. An example of a small portion of such a recording is shown in Fig. 1. Note that the neural discharges are essentially a digital code. The action potentials from one neuron are of fixed magnitude, and last about 1 ms. The analog recording is then passed through a window discriminator, which converts the action potentials into standard TTL pulses. The neural data is now in the form that can be analyzed by a digital computer.

Since action potentials from one neuron are of a fixed magnitude, the neural code cannot be in the form of amplitude modulation, but rather must rely on frequency modulation. All the information relating to the magnitude and quality of the stimulus must be contained in a frequency-modulated code. For example, the neural discharge pattern from a single fiber connected to a taste bud must convey not only information on the concentration of the stimulus but also on what kind of chemical has been applied to the tongue (eg., salty, sour, bitter, sweet-tasting).

Hardware

A block diagram of the interface is shown in Fig. 2 and a full schematic in Fig. 3. A crystal-controlled clock is set at a frequency of 1 kHz to give a pulse every 1 ms. These pulses are counted by a 16-bit binary counter. The least-significant byte of this count goes to one eight-bit input port, and the most-significant byte to a second port. One bit of an output port is used to reset the counter. A third port is used for input from the data pulses as well as the mark (stimulus beginning and end) and end analysis pulses. Since a 16-bit counter is used, 65,536 ms is the maximum interval that can be counted, which is more than sufficient for most neural data. The interface functions therefore in a very straightforward manner.

The computer first resets the counters, and then looks at the pulse mark and end port. When it meets a data pulse, the computer gets the input from the binary counters, resets the counters and looks for the next pulse. Whenever the mark bit is set, the computer then stores the next series of intervals in a second storage location. The reset pulse now not only resets the counters but also the mark bit.

The same series of events takes place when the mark pulse is set again (end of stimulation period). Finally after the poststimulus period the end bit is set and data analysis is finished. If the mark facility is not required, both the hardware and software become much simpler to design. Often, however, the time of stimulus onset can be very accurately determined and recorded on a second channel of the analog recording during the experiment. On playback, the stimulus marker channel can be used to control the mark input bit.

The schematic diagram is, for the most part, self-explanatory. The three input ports are neatly implemented using an 8255 programmable peripheral interface integrated circuit (see P. F. Goldsbrough's *Microcomputer Interfacing with the 8255 PPI Chip*). One of the ports is split into a four-bit input and four-bit output port.

I ran into a problem in the early design stages: the computer could store the interval data in a shorter time than the length of the data pulse. It therefore appeared to the computer as if a further input pulse was present when in fact it was not. To get around this problem, I used a "one and only one synchronizer" described in Don Lancaster's *TTL Cookbook*.

The incoming data pulse is used to gate a 1 μs clock pulse, which is used to set a flip-flop. Thus, the data pulse is converted to a pulse that the computer can reset once the interval has been stored. In effect, the incoming pulse is held until the computer acknowledges its presence. The use of this circuit gives very accurate interval measures.

The same type of circuit is used for the mark input pulse. The rest of the circuitry consists of address decod-

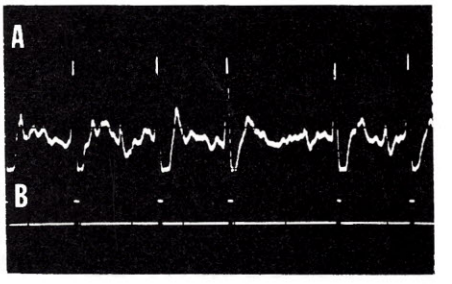

Fig. 1. a) Oscilloscope tracing of action potentials recorded from the chorda tympani nerve in a rat. b) TTL output pulses produced when the action potentials of 1a are passed through a window discriminator.

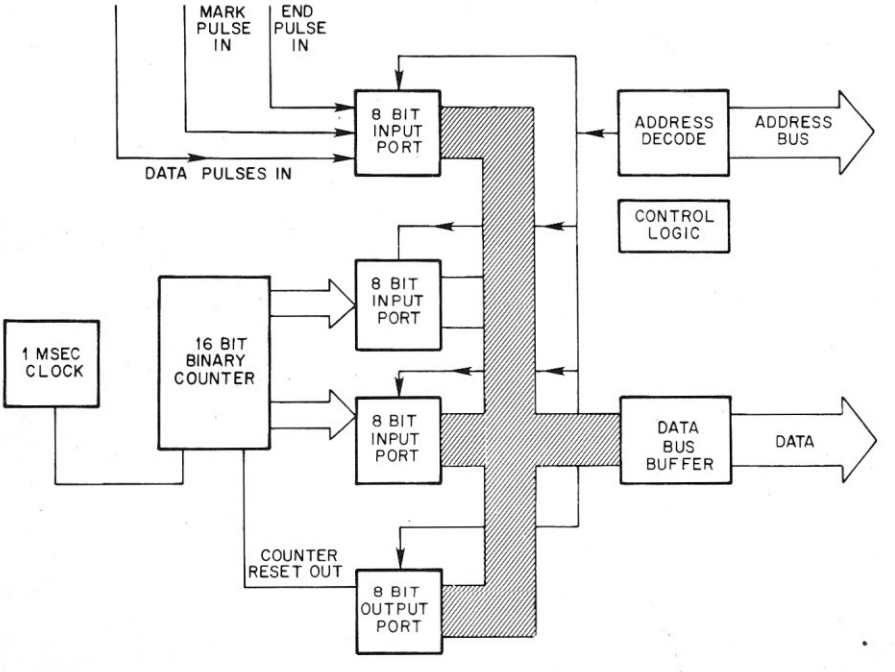

Fig. 2. Block diagram of an interface designed to measure the intervals between neural impulses.

ers, input control logic and switch debounce logic. For this application, the mark and end bits are set by momentary push-buttons. As I mentioned before, this could easily be done by using pulses recorded on magnetic tape during the experiment.

Software

I originally wrote the software in BASIC, which was far too slow for the speed of the neurophysiological data. The software listing of Fig. 4 is therefore in assembly language. A BASIC program analyzes the interval data stored on disk. (I haven't included mine here, since the program must be suited to individual needs.) Besides the fact that speed is not critical here, it would take me years to write a program in assembly language to analyze the data.

Analyzed data is plotted on both a line printer and an X-Y plotter through D-A converters. Statistical analyses are also printed on the line printer.

The initial part of the program sets up the transfer characteristics of the 8255. The program then asks for the output file name, and waits for the

Listing 1 continued.

```
;
NAMEIT  LXI     H,MES1   ;SET TO MESSAGE
        SCALL   .PRINT   ;GO PRINT IT
        LXI     H,FNAME  ;SET TO FILE NAME STORAGE
REA1    SCALL   .SCIN    ;GET CHARACTER
        JC      REA1     ;LOOP UNTIL READY
        MOV     M,A      ;STORE IT
        INX     H        ;BUMP IT
        CPI     0120     ;IS IT A 'CR'?
        JNZ     REA1     ;NOT YET
        DCX     H        ;YES SET BACK
        MVI     M,'.'
        INX     H
        MVI     M,'D'
        INX     H
        MVI     M,'A'
        INX     H
        MVI     M,'T'
        INX     H
        MVI     M,0      ;TERMINATE WITH 00 NOT 120
        MVI     A,1      ;CHANNEL 1
        LXI     D,DEFALT
        LXI     H,FNAME
        SCALL   .OPENW   ;OPEN CHANNEL
        JC      ERR1     ;ERROR TRY AGAIN
;
;     INITIALISE MEMORY AND WAIT FOR START
;     COMMAND
;
        CALL    INIT     ;SET UP MEM
        CALL    ZBUF     ;SET UP BUFFER
        LXI     H,MES4   ;READY TO START?
        SCALL   .PRINT   ;GO PROMPT
TERM    SCALL   .SCIN    ;GET REPLY
        JC      TERM
        CPI     00AH     ;IS IT A CR?
        JNZ     TERM     ;NO TRY AGAIN
;
;     START GETTING INTERVALS
;
        LXI     H,ON     ;SET TO MARK COUNTER
        MVI     M,000H   ;ZERO IT
        LXI     H,PRE    ;OKAY BEGIN-SET HL TO PRESTIM STORAGE
        LXI     D,2000D  ;SET UP MAX STORAGE COUNTER
        LXI     B,0000D  ;SET UP DATA POINT COUNTER
ZERO    MVI     A,010H   ;SET UP RESET BIT
        OUT     DATA3    ;RESET OUT
        MVI     A,000H   ;CANCEL
        OUT     DATA3    ;      IT
```

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user to type a carriage return to begin data entry. A program loop constantly examines the data input port, looking for data pulses, mark pulses or the stop bit. Prestimulus intervals are stored in one block of memory, stimulus intervals in another and poststimulus intervals in a third. The size of the assigned blocks are generous, and can be adjusted according to your needs.

Once the data has been entered, the program enters a binary-to-ASCII conversion routine, and the data is written to the output file (usually a disk). When the pre-, during- and post-blocks of memory are sequentially written to the output file, an asterisk is placed in the data stream on the disks between the blocks of data. Thus, when the disk is subsequently read, the BASIC program can use these markers in data analysis.

Because the program is written for the Heath disk operating system, it uses various system calls and begins above the first 8K of memory. These may have to be altered to run on other machines.

Conclusions

We've been using this system in the

Listing 1 continued.

```
WAIT    IN      DATA3   *GET DATA PORT
        ANI     00FH    *MASK OUT UPPER NIBBLE
        CPI     001H
        JZ      COUNT   *PULSE PRESENT GO GET INTERVAL
        CPI     000H
        JZ      WAIT    *NO PULSE YET TRY AGAIN
        CPI     002H
        JZ      WAIT    *STILL NOT READY
        CPI     003H
        JZ      MARK    *MARKER AND PULSE PRESENT CHANGE STORAGE
        CPI     006H    *MARKER AND END BIT SET?
        JZ      AFT     *YES FIX AND CONVERT
        JMP     CONVT   *NON OF ABOVE MUST HAVE ENDED INPUT
MARK    IN      DATA1
        MOV     M,A
        INX     H
        INX     B
        IN      DATA2
        MOV     M,A
        INX     H
        INX     B
        LXI     H,ON    *SET TO MARK COUNTER
        MOV     A,M     *BRING IT INTO A
        CPI     000H    *IS IT SET?
        JNZ     MARK2   *YES SET TO NEXT BLOCK
        INR     M       *SET IT
        PUSH    B       *COPY B-C
        POP     H       *INTO H-L
        SHLD    PRESTIM *STORE COUNT
        LXI     B,00000D
        LXI     H,STIM  *SET H-L TO STIM STORAGE
        JMP     ZERO    *GO DO MORE
MARK2   PUSH    B       *COPY B-C
        POP     H       *  INTO H-L
        SHLD    DUSTIM  *SAVE B-C COUNT
        LXI     B,0000D *ZERO B-C
        LXI     H,POST  *SET H-L TO POST STIM
        JMP     ZERO    *DO MORE
COUNT   IN      DATA1   *GET LSBYTE
        MOV     M,A     *STORE IT
        INX     H       *SET TO NEXT LOC
        INX     B       *COUNT IT
        IN      DATA2   *GET MSBYTE
        MOV     M,A     *STORE IT
        INX     H       *BUMP MEM
        INX     B       *COUNT IT
        DCX     D       *IS DE ZERO YET?
        MOV     A,D
```

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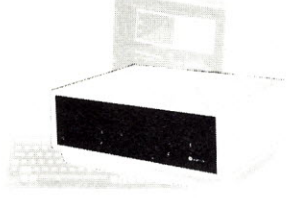

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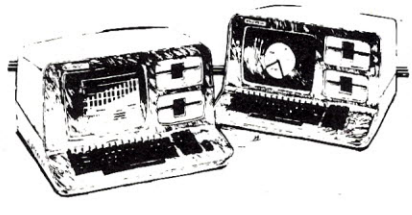

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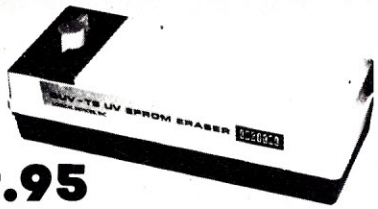

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Listing 1 continued.

```
        ORA     E
        JNZ     ZERO    *NO DO SOME MORE
AFT     PUSH    B       *COPY BC INTO
        POP     H       *   INTO HL
        SHLD    DUSTIM  *SAVE DATA POINT COUNT
        LXI     B,0000D *RESET DATA POINT COUNTER
        LXI     H,POST  *SET TO NEXT STORAGE AREA
CONUT   IN      DATA1   *GET LAST INT
        MOV     M,A
        INX     H
        INX     B
        IN      DATA2
        MOV     M,A
        INX     B
        PUSH    B       *COPY B-C
        POP     H       *INTO H-L
        SHLD    POSTIM  *STORE COUNT
        LXI     H,BUFFR *SET TO START OF BUFFER
        SHLD    TRANS   *STORE START ADDRESS
        LXI     H,256D  *LOAD HL WITH BUFFER COUNT
        SHLD    ZEROM   *STORE COUNT
        LXI     H,FLAG  *SET TO FLAG LOC
        MVI     M,000H  *ZERO IT
        LXI     H,ON    *SET TO MARK STORAGE COUNTER
        MVI     M,000H  *ZERO IT
        LHLD    PRESTIM *GET PRESIM DATA COUNT
        PUSH    H       *AND COPY IT
        POP     B       *  INTO B-C
        LXI     H,PRE   *SET TO PRESTIM STORAGE
*
*     BEGIN BINARY TO ASCII CONVERSION
*
AGAIN   LXI     D,10000D
        CALL    DIVIDE
        LXI     D,1000D
        CALL    DIVIDE
        LXI     D,100D
        CALL    DIVIDE
        LXI     D,10D
        CALL    DIVIDE
        LXI     D,1D
        CALL    DIVIDE
        DCX     B
        MOV     A,B
        ORA     C
        JZ      DONE
        DCX     B
        MOV     A,B
        ORA     C
        JZ      DONE
        INX     H       *SET TO NEXT INT PAIR
        INX     H
MORE    MVI     A,' '   *SET UP A SPACE IN A
        CALL    BUFIT   *GO STORE IT
        PUSH    H
        LXI     H,FLAG  *RESET FLAG
        MVI     M,000H
        POP     H
        JMP     AGAIN   *DO ANOTHER
DIVIDE  PUSH    H
        LXI     H,ASCII *SET TO ASCII COUNTER
        MVI     M,02FH  *STORE ONE LESS THAN ASCII 0
        POP     H
DLOOP   MOV     A,M
        SUB     E
        MOV     M,A
        INX     H
        MOV     A,M
        SBB     D
        MOV     M,A
        PUSH    H
        LXI     H,ASCII
        INR     M
        POP     H
        DCX     H
        JNC     DLOOP
        MOV     A,M
        ADD     E
        MOV     M,A
        INX     H
        MOV     A,M
        ADC     D
        MOV     M,A
        PUSH    H
        LXI     H,ASCII
        MOV     A,M
        POP     H
        DCX     H
        PUSH    H       *SAVE IT
*
*     LEADING ZERO SUPPRESSION
*
        CPI     '0'     *DOES IT CONTAIN AN ASCII 0
        JNZ     OKPRT   *NO GO SAVE IT
        LXI     H,FLAG  *YES WHAT IS FLAG STATUS?
        MOV     A,M
        RAR
        LXI     H,ASCII *GET ASCII BACK
        MOV     A,M
        JC      OKPRT   *GO SAVE IF CARRY SET
        POP     H       *OTHERWISE DISCARD
        RET
OKPRT   LXI     H,FLAG  *SET FLAG
        MVI     M,001H
        POP     H
*
*     STORE ASCII OUTPUT IN BUFFER
```

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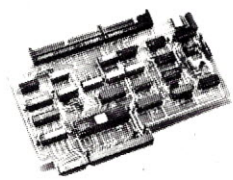

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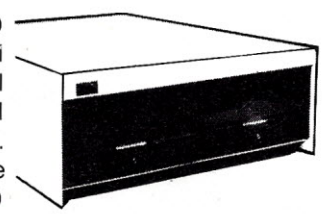

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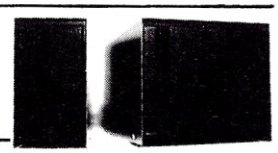

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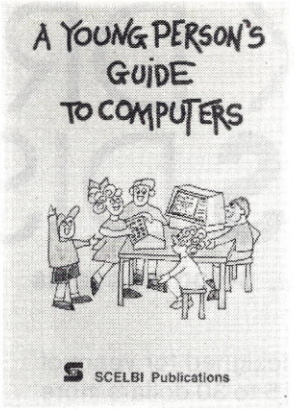

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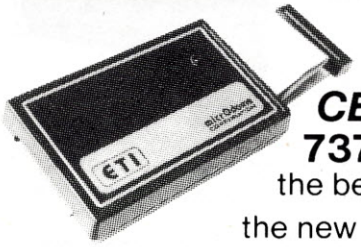

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Listing 1 continued.

```
BUFIT   PUSH    H
        LHLD    TRANS   *GET CURRENT BUFFER LOC
        MOV     M,A     *STORE CONTENTS OF A
        INX     H       *BUMP BUFFER STORAGE LOC
        SHLD    TRANS   *STORE IT
        LHLD    ZEROM   *GET CURRENT BUFFER COUNT
        DCX     H       *DECREMENT IT
        SHLD    ZEROM   *STORE IT
        MOV     A,H     *IS BUFFER COUNT
        ORA     L       *  ZERO YET?
        POP     H
        CZ      WRITE   *GO WRITE IF SO
        RET             *OTHERWISE RETURN
*
*     WRITE ASCII BUFFER TO OUTPUT FILE
*
WRITE   MVI     A,1     *WRITE ON CHANNEL 1
        PUSH    H       *SAVE ALL REGS
        PUSH    B
        PUSH    D
        LXI     B,256D
        LXI     D,BUFFR
        SCALL   .WRITE  *GO WRITE BUFFER
        JC      ERR2
        CALL    ZBUF
        POP     D
        POP     B
        LXI     H,BUFFR *SET TO BUFFER START ADD
        SHLD    TRANS   *GO STORE IT
        LXI     H,256D  *RESET BUFFER COUNTER
        SHLD    ZEROM   *AND STORE IT
        POP     H
        RET             *NO DO SOME MORE
DONE    LXI     H,ON    *CHECK MARKER COUNT STAT
        MOV     A,M
        CPI     000H    *IS IT ZERO?
        JNZ     DONE1   *NO SET TO NEXT BLOCK
        INR     M       *YES-SET IT TO 1
        MVI     A,'*'
        CALL    BUFIT   *GO STORE AN ASTERISK
        LHLD    DUSTIM  *LOAD H-L WITH COUNT
        PUSH    H       *  AND COPY
        POP     B       *  IT INTO B-C
        LXI     H,STIM  *SET TO NEXT BLOCK
        JMP     MORE    *GO DO SOME MORE
DONE1   CPI     001H    *IS IT SET TO 1?
        JNZ     DONE2   *NO MUST BE FINISHED
        INR     M       *YES SET TO 2
        MVI     A,'*'
        CALL    BUFIT   *GO STORE AN ASTERISK
        LHLD    POSTIM  *LOAD H-L WITH COUNT
        PUSH    H       * AND COPY IT
        POP     B       *  IT INTO B-C
        LXI     H,POST  *SET H-L TO NEXT BLOCK
        JMP     MORE
DONE2   LHLD    TRANS
        MVI     M,012Q
        INX     H
        MVI     M,012Q
        MVI     A,1
        LXI     B,256D
        LXI     D,BUFFR
        SCALL   .WRITE
        JC      ERR2
        JMP     EXIT
*
*     MISCELLANEOUS SUBROUTINES
*
INIT    LXI     H,PRE
        LXI     B,500D
NEXT    MVI     M,000H
        INX     H
        DCX     B
        MOV     A,B
        ORA     C
        JNZ     NEXT
        LXI     H,STIM
        LXI     B,3000D
NEXT2   MVI     M,000H
        INX     H
        DCX     B
        MOV     A,B
        ORA     C
        JNZ     NEXT2
        LXI     H,POST
        LXI     B,500D
NEXT3   MVI     M,000H
        INX     H
        DCX     B
        MOV     A,B
        ORA     C
        JNZ     NEXT3
        RET
ZBUF    LXI     H,BUFFR
        LXI     D,256D
DOAG    MVI     M,000H
        INX     H
        DCX     D
        MOV     A,D
        ORA     E
        JNZ     DOAG
        RET
ERR1    LXI     H,FILER *SET TO ERROR MESSAGE
        SCALL   .PRINT  *PRINT IT
        JMP     NAMEIT  *TRY AGAIN
ERR2    LXI     H,MES6  *SET UP ERROR MESSAGE
```

More →

laboratory for some time now, and are pleased with the results.

Someone may ask why I didn't design the interface to measure frequency directly since the neural code is frequency modulated. It would in fact have been much simpler to do this, and only an eight-bit binary counter would have been required. However, average frequency obscures many of the subtleties of neural discharge patterns that may be an important part of the code. By measuring intervals between action potentials, all forms of data analysis become possible, including instantaneous and average frequency.

Techniques such as have been described here are neither new nor original, and have been used for some time by individuals with access to large, expensive computer systems. With the advent of small, relatively inexpensive computers, this facility is available to most neurophysiology laboratories. ■

Listing 1 continued.

```
        SCALL   .PRINT
        XRA     A
        SCALL   .EXIT   *TRY AGAIN
EXIT    MVI     A,1
        SCALL   .CLOSE
        JC      ERR2
        LXI     H,MES5
        SCALL   .PRINT
REA2    SCALL   .SCIN
        JC      REA2
        CPI     'Y'
        JZ      NAMEIT
        XRA     A
        SCALL   .EXIT
*
*       MESSAGES
*
MES1    DB      12O,'FILE NAME? EG. SY1:NAME.THE COMPUTER WILL ADD .DAT',' '+200
O
FILER   DB      12O,'ERROR IN FILE NAME',' '+200O
MES4    DB      12O,'PRESS RETURN WHEN READY',' '+200O
MES5    DB      12O,'ANALYSE MORE DATA? Y OR N.',' '+200O
MES6    DB      12O,'SERIOUS ERROR',' !'+200O
DEFALT  DB      'SY0:',0,0,0
PRE     DS      500D
POST    DS      500D
STIM    DS      3000D
PRESTIM DS      2D
POSTIM  DS      2D
DUSTIM  DS      2D
ON      DS      1D
BUFFR   DS      256D
ASCII   DS      001H
DCOUNT  DS      002H
ZEROM   DS      002H
FLAG    DS      001H
TRANS   DS      002H
FNAME   DS      20D
        END     BEGIN
```

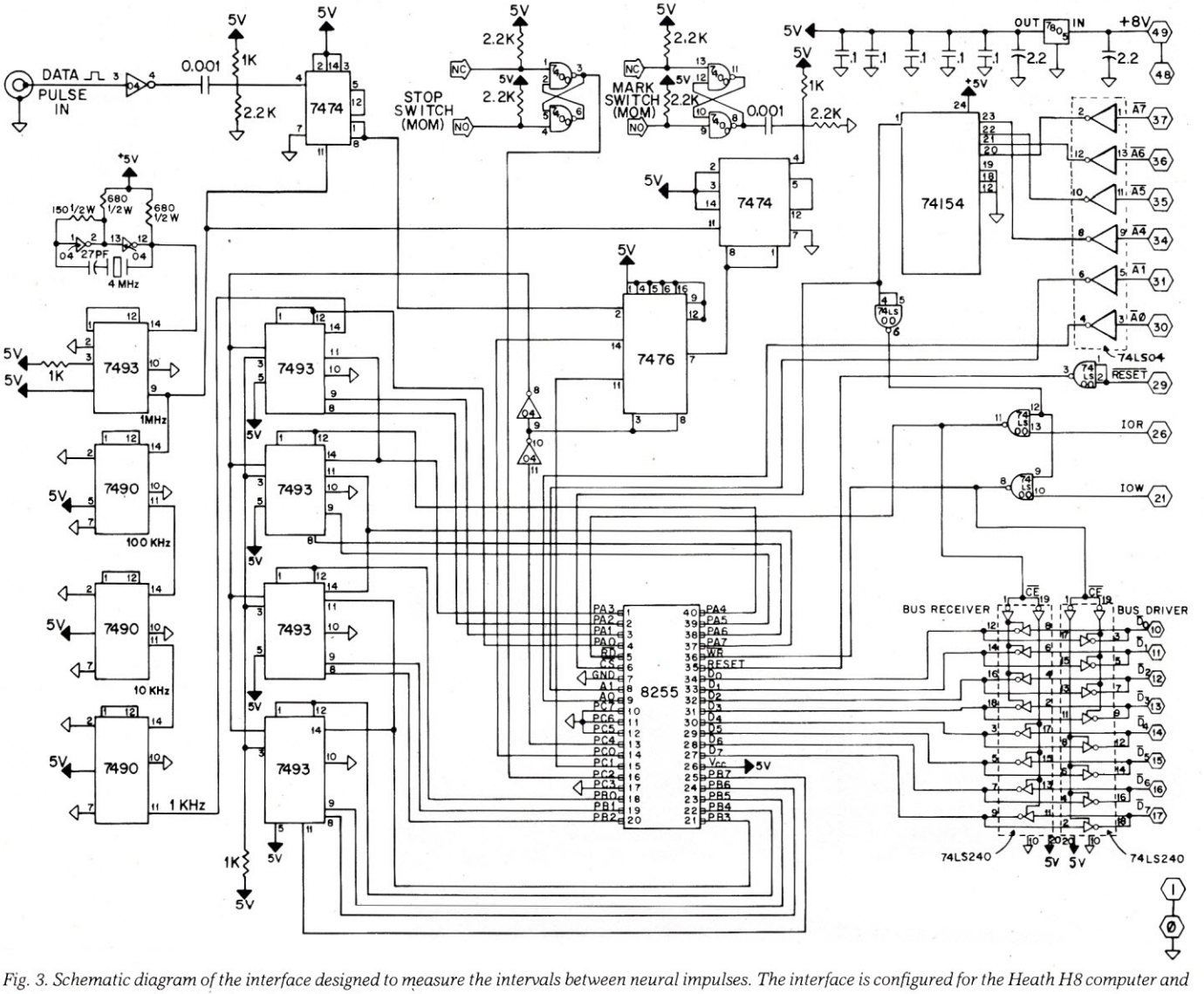


Fig. 3. Schematic diagram of the interface designed to measure the intervals between neural impulses. The interface is configured for the Heath H8 computer and the bus connections are therefore defined for that machine.

Ever wonder what puts the twinkle in those little stars? Well, at the Strasenburgh a microcomputer is responsible for those special effects.

Planetarium Shows With a Difference

By Susannah C. West

Imagine you're sitting in a planetarium, waiting for the show to start. The lights dim slowly and stars appear on the darkened dome above you, as clean and bright as if you were miles out in the country. The show begins. But in this show, you see and experience much more than stars. Comets streaking across the sky. The eerie flicker of the Aurora Borealis. A tiny earth as seen from space, revolving silently, high on the dome above you. A violent blinding flash, so sudden that it shakes you in your seat—a sun going nova.

Many modern planetarium shows feature such spectacular special effects, rivaling those in today's movies. With the help of a computer to automatically coordinate the production of these special effects, they can be astonishingly realistic.

A Computer-Automated Planetarium

The Strasenburgh Planetarium of the Rochester Museum & Science Center in Rochester, NY, is a leading example of a computerized planetarium. When the Strasenburgh opened in 1968, a custom-designed system controlled by a PDP-8 computer produced its shows' effects. Last summer, the planetarium switched from the PDP-8 to a microcomputer system designed specifically for producing multimedia shows—the MC-10 Media Control System, manufactured by R. A. Gray, Inc. of San Diego, CA.

The decision to switch was prompted by the fact that the PDP-8 was obsolete—parts and service were becoming increasingly difficult to obtain. After 13 years, the old system was still working "virtually perfectly," according to planetarium director Don Hall, who adds that "to get the kind of service we've had out of it is just miraculous. However, it was obvious that we had to junk a working system and buy something to replace it, just so we would get parts and service and be confident that we were going to be able to remain in business."

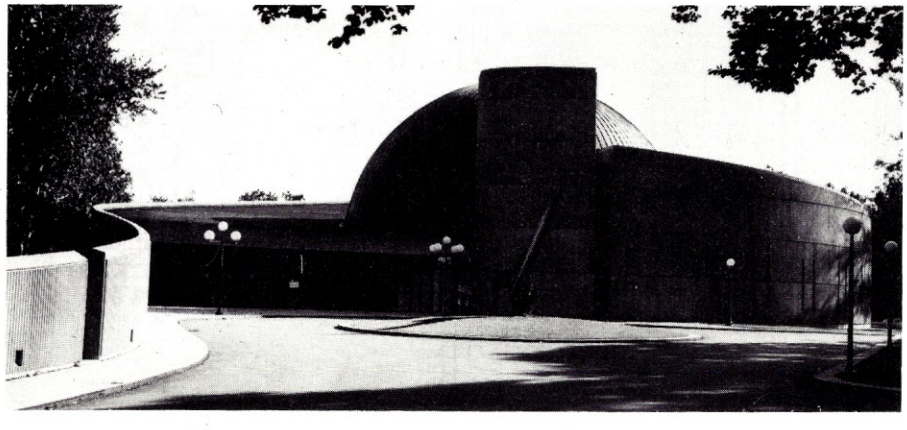


Photo 1. Strasenburgh Planetarium of the Rochester Museum & Science Center. (Photo by William G. Frank.)

The careful search for a new system took about a year, and others besides the MC-10 were considered. The staff found out about the MC-10 through word of mouth—from a former Strasenburgh intern who had gone on to the Reuben H. Fleet Space Theater in San Diego, which uses an MC-10 to produce its special effects.

"The MC-10 is essentially a microprocessor that is built by another San Diego company called Gnat," explains Hall. "They build the brain, you might say, and then R. A. Gray builds the various modules that allow it to control the devices in the planetarium theater. So if you have ten Carousel projectors that you want to control in the theater, you buy ten Carousel units as part of your computer system. You buy just what you need, and you can expand the system, because it is modular."

The planetarium staff planned the switch-over carefully. After receiving the MC-10 equipment, they spent about four months learning about the system and interfacing it with the planetarium's devices. During this phase, the PDP-8 continued to produce the special effects for shows.

On June 21, 1981, the final installation began, right on schedule. It took five days to move out the old equipment, move in the new equipment and plug it in. "Except for a few initial difficulties," says chief technician Carl Dziedziech, "she's been quite good—hasn't given us any problems."

R. A. Gray describes the MC-10 as a "general-purpose media controller

Susannah C. West (224 Selye Terrace, Rochester, NY 14613) is a free-lance writer.

designed especially for recording and playbacks of multimedia presentations." The hardware consists of two disk drives, used to record and store performance information, two monitors, a keyboard and a variety of modules that can control up to 120 devices at one time. These can include not only equipment like lights and projectors, but also tape machines, speakers, robots and puppets.

The MC-10 incorporates three levels of operation. The highest level (maintenance) allows development of all features of the operating environment. Devices can be added or removed from the working environment and named as they will be displayed on the monitors. When it becomes necessary, the system can also be tested for maintenance.

The second level (production) allows editing and storage of "scripts" of performances. Because the system recognizes commands in English, programming is no problem, even for the computing novice.

The third level (operation) is for playback and setup. The play mode recalls previous performances. The setup mode allows user control of devices in real-time without recording for review and experimentation without editing.

At either of the first two levels, disks can be produced to allow functions at or below that level and no higher. Thus, disks for production are unable to destroy or modify the basic system features and controls; and disks for playback cannot be erased or edited by operators. This scheme provides both protection and security.

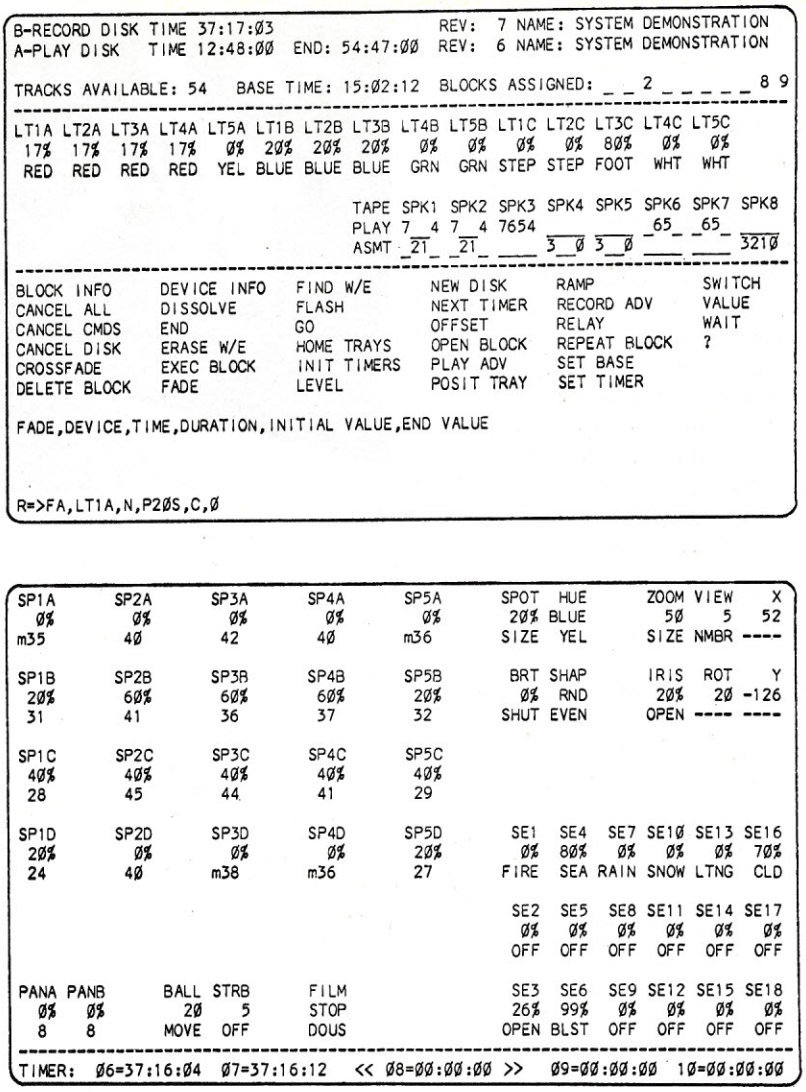


Fig. 1. Typical video display. (Source: R. A. Gray, Inc.)

Recording Shows with the MC-10

"When we want to record a 45-minute show," says Hall, "we break it up into ten or 20 shorter sequences which are each only a few minutes long. We go into the theater with the script with the cues marked in the margin. Two or three people are standing there at the console with their hands on the controls, and are actually giving the show."

The soundtrack for the show has already been taped and is played.

"One person's reading the script," Hall continues, "and he says the cues to the technicians who are operating the effects. And the narrator says, 'And so the rocket takes off for Mars,' and the person giving the cue says, 'All right, fade up C3, hit the non-dim

What Makes The Stars Shine?

Although the universe is not actually a sphere, it is convenient to think of it that way. To reproduce the stars in a planetarium sky via its star projector, the celestial sphere is approximated with an icosadodecahedron, a 32-sided solid made up of pentagons and hexagons.

Each star which falls inside one of these areas is reproduced as a tiny opening in a transparent photographic slide. These holes vary in size according to the brightness of the actual stars. Each slide is lit by a central light source, which passes through the holes and focuses on the planetarium dome. A planetarium projector also incorporates individual projectors which reproduce the brightest stars in the sky, the sun, the moon and the five visible planets.

A number of firms make plane-

(continued on p. 82)

(continued from p. 81)

tarium projectors which follow the same principle. But the Strasenburgh's projector is a very special one. It's a Zeiss model VI—a Rolls-Royce among planetarium projectors. Built by the West German firm of Carl Zeiss, Inc., it includes many sophisticated components. The most complex of these is the moon projector, which reproduces the phases of the moon and five kinds of lunar eclipses. It also features a sun projector capable of showing the sun's position in the sky for any day of the year, and ten kinds of solar eclipses.

The Star Theatre

With a star projector like the Zeiss, you'd expect the Strasenburgh's Star Theatre to be special too, and it is. It seats 240 people under its 65-foot diameter dome. The seats swivel and recline so you can look up at the dome without getting a stiff neck. You hear the narration from speakers built into the chairs, next to your ears, and music and sound effects from speakers set in the dome.

Narration, music and sound effects are sent to the theater from the control room, which contains the recorders and amplifiers. A projection gallery surrounding the theater contains about 300 projectors which are aimed at different parts of the planetarium sky. The number of projectors varies according to the number needed for the various shows running at any particular time.

The planetarium features several shows simultaneously. A 45-minute show which explores such things as phenomena of the universe or space exploration runs several times a day and in the evening. A 20-minute minishow about the seasonal sky also runs in the evening.

There are shows designed for family audiences, preschool shows which combine live action with star projections, and shows for school groups. In addition, there are special shows, like the 3-D light show which ran during the summer of 1981. And the planetarium staff is always working on shows that will replace current ones when their runs are through.■

Photo 2. Chief technician Carl Dziedziech at Planetarium console. MC-10 is in background to the left. (Photo by Victor A. Costanzo, Jr.)

and fade up E4.' And those cues 'cause' the rocket to take off for Mars."

Sequences are rarely right the first time. With the old system, perfecting a sequence was laborious, even if only one problem occurred, because the entire sequence would have to be rerecorded. But the MC-10, Hall explains, "allows us to edit the show, once it's been put in, much more easily. If just one thing needs to be done, like a light that fades down just a little too quickly, that part alone can be edited without affecting the other parts of the sequence that don't need changing."

When a show is being recorded, "the computer is scanning all the controls on the console. If anything is moved, it notes its position, and the next time the computer scans around, it will compare the second scan with the first scan; if anything has moved, it makes a note of where it is now. When it comes to the playback of those instructions, we tell the computer, 'Now play back the show.' The computer grabs hold of the controls and will actually operate them."

To develop programs more conveniently, and to have a backup system, two computers were purchased. One computer "sits in the control room and gives the show," says Hall. The other "allows a person to sit in his office, use the typewriter keyboard attached to it and the two monitors, and program the show, just watching numbers appear and change on the screen, take the program on the floppy disk, put it in the computer in the theater, and adjust it there. So recording can be done off-line."

Planetarium Console

The planetarium console is located at the back or side of any planetarium theater. It is here that the operator sits to deliver a show, manipulating knobs and buttons to project images on the dome and operating the star projector so that the appropriate stars will appear. If it's a live rather than recorded show, he delivers the lecture.

The Strasenburgh's console was originally built for use with the PDP-8, but when the decision was made to switch to the MC-10, the console was almost completely redesigned by a time-motion studies expert. Its appearance is quite similar, but there are also differences. For instance, many of the special effects control knobs were replaced with slider controls.

The MC-10 is also part of the console. The video displays show the operator what's going on with the special effects: which projectors are on at any given moment and what their brightness is. By watching the monitors, the operator can easily tell, for example, if a projector bulb is burnt out or if an effect is out of sequence. School shows are usually run manually with a live lecturer, and so the console was designed to allow operation without the MC-10.

Results

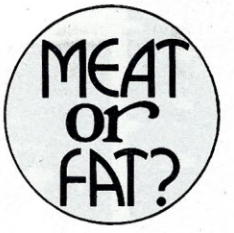
Audiences can't really detect the difference between a show produced by the old system and one produced by the MC-10. However, there *are* differences—and all to the good. Formerly, it took five people two full days to record a show. In contrast, the first shows produced using the MC-10 were recorded by four people in about five hours. As the staff becomes more accustomed to the system, they will be able to record shows in even less time.

In addition, more complicated effects can be achieved with the MC-10. It gives a greater degree of control, so that technicians can do precisely what they want with the effects. The current show, which opened in mid-October 1981, features effects that would have been impossible or very difficult to produce using the old system.

Future for the MC-10

Although the planetarium staff is pleased with the MC-10's performance, there's still a lot of work to be done. Right now, only the special ef-

Are you looking for. . .



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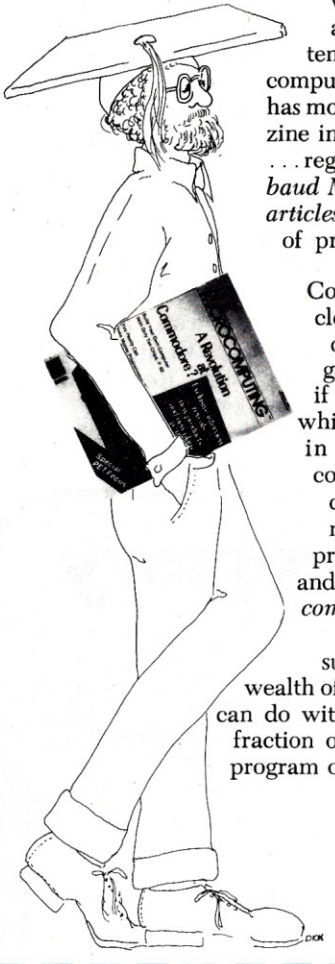

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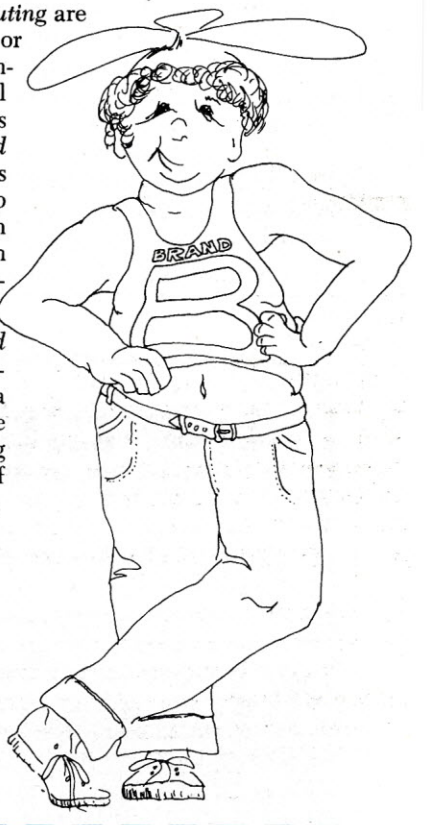

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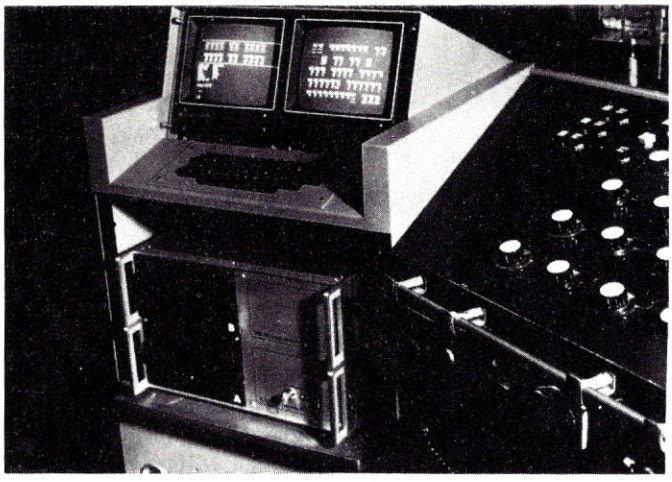

Photo 3. Close-up of MC-10. (Photo by Victor A. Costanzo, Jr.)

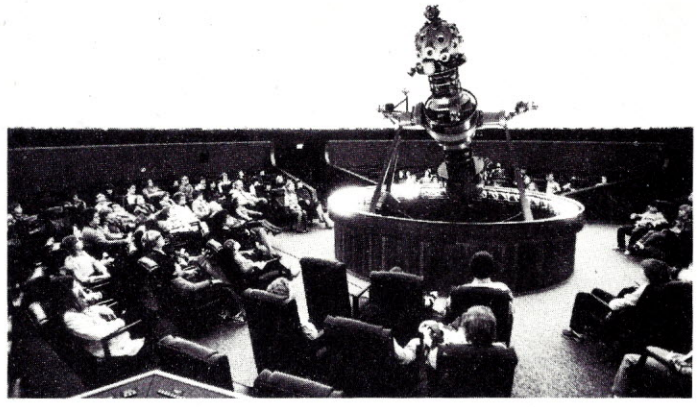

Photo 4. Planetarium's Star Theatre with Zeiss Star Projector in center. (Photo by William G. Frank.)

fects are controlled by the system. However, work has begun on interfacing it with the planetarium's star projector to control its operation.

"It will be a one-on-one situation where we'll be changing over functions one at a time, interfacing on a piecemeal basis, testing as we go along," says Dziedziech, adding that "not all the system gets automated—only those functions that are used 80–90 percent of the time will be computerized." The projector will be automated by the spring of 1982.

Through this combination of technology and theater, the Strasenburgh Planetarium will strive to produce high-quality shows that will both teach and entertain.■

References

The MC-10 Media Control System was developed by R. A. Gray, Inc., 9181 Chesapeake Drive, San Diego, CA 92123. 714-560-4162.

The internal computer was manufactured by Gnat Computers, Inc., Building 6, 7895 Convoy Court, San Diego, CA 92111. 714-560-0433.

For more information about the Strasenburgh Planetarium, contact: Donald S. Hall, Director, Strasenburgh Planetarium, Rochester Museum & Science Center, 657 East Ave., PO Box 1480, Rochester, NY 14063. 716-271-4320.

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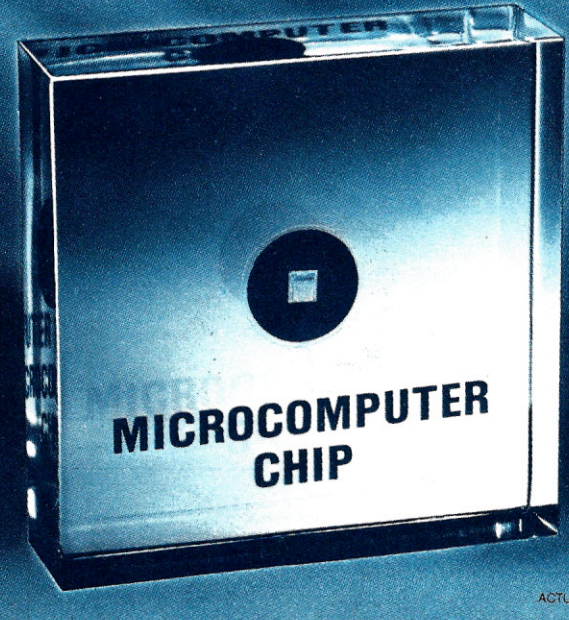

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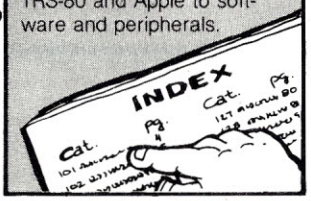

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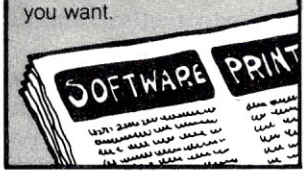

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Immune to the effects of poisonous substances, the Apple microcomputer is a perfect lab assistant to measure toxic health hazards.

The Toxic Apple

By Paul E. Gurba, Rolf A. Deininger and Carl F. Berger, Jr.

```
0  REM  AMINCO DATA LOGGING PROGRAM
10  GOTO 110
20 NS = 0
30  FOR I = 1 TO 300
40 NS = NS + 1
50 X =  PEEK ( - 16384): IF X > 127 THEN 360
60  POKE AP1,CH:R(I) =  PEEK (A)
70  PRINT R(I) * .0483
80  FOR D = 1 TO DL: NEXT D
90  NEXT I
100  GOTO 360
110  HOME : PRINT "        THIS PROGRAM STORES"
120  PRINT "    DATA TAKEN FROM THE AMINCO"
130  PRINT "    SPECTROPHOTOMETER"
140  FOR I = 1 TO 1500: NEXT I
150  HOME :A =  - 14592:AP1 = A + 1:D$ =  CHR$ (4):CH = 2
160  DIM R(300)
170  PRINT "WHAT IS THE SAMPLE NAME": INPUT SN$
180  PRINT "ENTER DATE": INPUT DT$
190  PRINT "NAME OF OPERATOR": INPUT NO$
200  PRINT "WHAT TIME BASE ARE YOU USING": INPUT T
210  IF T >  = 5 AND T <  = 50 THEN  GOTO 230
220  PRINT "THE TIME BASE SHOULD BE BETWEEN 5 AND 50": GOTO 200
230  IF T = 5 THEN DL = T * 21.7
240  IF T = 50 THEN DL = T * 120
250  IF T = 20 THEN DL = T * 28.6
260  IF T = 10 THEN DL = T * 24.7
270  PRINT "ABSORBTION SCALE";
280  INPUT AB
290  PRINT "DO YOU WANT TO SAVE THE DATA": INPUT SV$
300 FAC = .0483
310  PRINT "TO START OR STOP TAKING DATA, PRESS ANY KEY"
320 X =  PEEK ( - 16384)
330  IF X < 127 THEN 320
340  POKE  - 16368,0
350  GOTO 20
360  PRINT NS;" DATA POINTS TAKEN."
370  IF SV$ = "Y" THEN 390
380  GOTO 460
390  PRINT D$;"OPEN";SN$ + "." + DT$
400  PRINT D$;"WRITE";SN$ + "." + DT$
410  PRINT SN$: PRINT DT$: PRINT NO$: PRINT T: PRINT AB: PRINT NS
420  FOR I = 1 TO NS
430  PRINT R(I)
440  NEXT I
450  PRINT D$;"CLOSE";SN$ + "." + DT$
460  END
```

Listing 1. Program used to collect and save data generated by the Aminco analyzer.

Toxicology is the science which deals with the effects of toxic substances (such as pesticides) on living organisms.

To determine the potential and actual health hazard, scientists often measure enzymatic reactions. Many of the pesticides are commonly evaluated for their ability to inhibit acetylcholinesterase (an enzyme), which is important in nervous system functions. The enzyme activity is monitored by the light absorption of a colored complex of DTNB (dithionitrobenzoic acid) and thiocholine, which is released during the course of the reaction. The change in light absorption is monitored continuously with time at 412 nm (nanometers), and the result is recorded on an x-y recorder.

The enzyme activity is then computed using the slope of the tracing along with other parameters such as cuvette volume, amount of protein and molar extinction coefficient. Materials which are inhibitory to acetylcholinesterase will show a lower activity than a control compound.

Although the computation of such enzyme activities is not difficult, the task can be time-consuming when a large number of compounds need to be screened. Additionally, the tracing obtained is not always linear, so there is a need for some way of obtaining a slope by methods less biased than eyeballing it. Once the raw data is collected, statistics and report gener-

Address correspondence to Paul E. Gurba, Rolf A. Deininger, and Carl F. Berger, Jr., Department of Environmental and Industrial Health, School of Public Health, The University of Michigan, Ann Arbor, Michigan 48109.

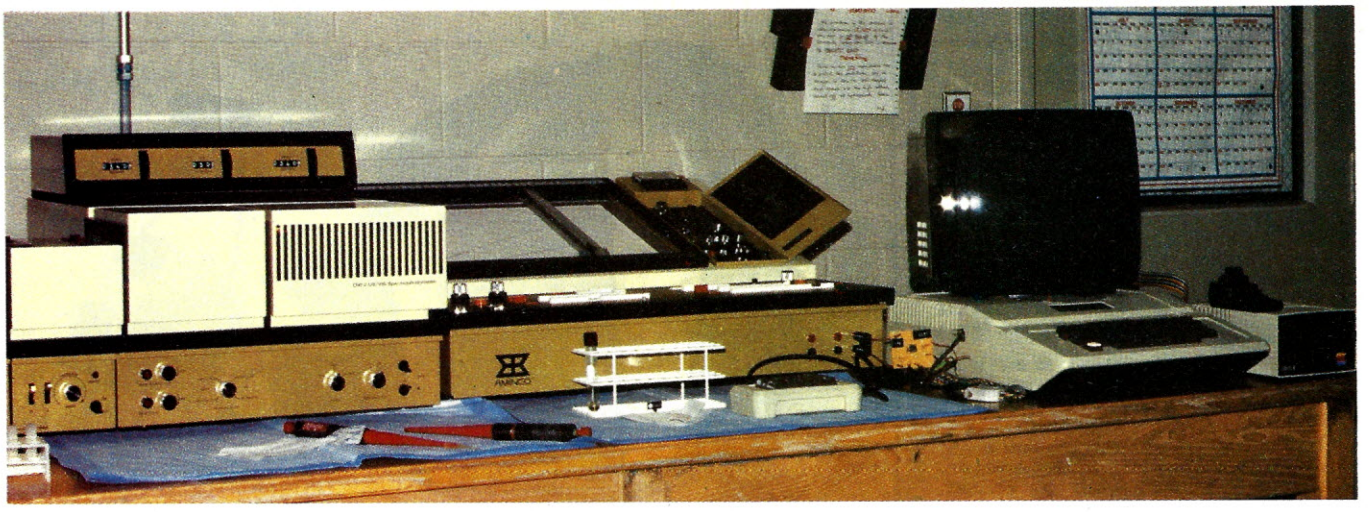

Photo 1. Aminco recording spectrophotometer with Apple II.

ation are often necessary. We decided therefore to explore the use of an Apple microcomputer for data logging and analysis.

The System

Photo 1 shows the instrument used in our studies: a recording spectrophotometer marketed by the American Instrument Company under the name Aminco. It consists of a photomultiplier, dual monochrometers and an x-y recorder. The signals to the recorder are available at an output port. A small operational amplifier system (shown with an Interactive Structures A/D converter in Photo 2) scales the output voltage of the Aminco by a factor of about 80. The circuit consists of an LM308 operational amplifier with an input resistance of 13k ohms and a 1 Megohm feedback resistor to produce the desired amplification. A .01 microfarad capacitor is used for noise and internal compensation. The sample is then processed by an eight-bit A/D converter.

Listing 1 shows the program used to collect the data from the instrument. Statements 110 through 340 acquire information on the sample, operator and analysis. Statements 230 through 260 set the delay times for various speeds of analysis. Statement 150 sets the proper slot addresses of the A/D converter, channel number and amplification factor. In response to pressing a key, the actual sampling loop begins at statement 20 and ends at statement 100. Up to 300 samples (which is much more than enough) can be taken. Statements 360 through 460 record all data and the other information on the disk.

Listing 2 shows the program used

```
0  REM  AMINCO DATA ANALYZER
10  ONERR  GOTO 80
20  DIM R(400)
30  INPUT "WHAT DATA FILE DO YOU WANT? ";FI$
40 D$ =  CHR$ (4)
50  PRINT D$;"OPEN";FI$: PRINT D$;"READ";FI$
60  INPUT SN$: INPUT DT$: INPUT NO$: INPUT T: INPUT AB: INPUT NS
70  FOR I = 1 TO NS: INPUT R(I): NEXT I
80  PRINT D$;"CLOSE";FI$
90  CALL  - 936: HGR : HCOLOR= 3: SCALE= 3: ROT= 0
100  HPLOT 0,0 TO 279,0 TO 279,159 TO 0,159 TO 0,0
110 XINC = 279 / NS:YINC = 159 / 255
120  FOR I = 1 TO NS
130 X = XINC * I:Y = 159 - YINC * R(I)
140  HPLOT X,Y: NEXT I
150  GET T$
160  VTAB 21: PRINT "ADJUST PADDLE FOR LOW DATA POINT,           PRESS A KEY"
170  GOSUB 440
180 IB =  INT (X / 255 * NS)
190  VTAB 21: PRINT "ADJUST PADDLE FOR HIGH DATA VALUE,        PRESS ANY KEY"
200  GOSUB 480
210 IE =  INT (X / 255 * NS)
220  TEXT
230  REM  SLOPE
240 AD = .0445
250 SX = 0:SY = 0:XY = 0:X2 = 0:N = 0
260  FOR I = IB TO IE
270 X = I / 20
280  PRINT "X= ";X,"Y= ";R(I) * AD
290 N = N + 1
300 SX = SX + X:SY = SY + R(I) * AD
310 XY = XY + X * R(I) * AD:X2 = X2 + X * X
320  NEXT I
330 SL = (SX * SY - N * XY) / (SX * SX - N * X2)
340 AS = AB * SL
350  PRINT "THE SLOPE IS ";SL: PRINT "YOU USED ";N;" DATA POINTS"
360  PRINT "INPUT MILLILITERS VOLUME": INPUT MV
370  PRINT "INPUT THE MOLAR EXTINCTION COEFICIENT": INPUT E
380  PRINT "INPUT MILLIGRAMS PROTEIN": INPUT P
390 MO = (AB / 10) * (1 / E) * (MV / 1000)
400 TI = T * (1 / 60)
410 SP = SL * (MO / TI / P)
420  PRINT "THE SPECIFIC ACTIVITY IS ";SP
430  END
440  REM  LINES 1010-1030 DEFINE CURSOR
450  FOR I = 0 TO 11: READ BYTE: POKE 768 + I,BYTE: NEXT I
460  DATA  1,0,4,0,63,9,9,63,18,36,36,0
470  POKE 232,0: POKE 233,3
480 X =  PDL (0) * 1.0941:Y =  PDL (1) * .6235
490  XDRAW 1 AT X,Y
500  FOR D = 1 TO 60: NEXT D
510  XDRAW 1 AT X,Y
520 U =  PEEK ( - 16384): POKE  - 16368,0
530  IF U < 127 THEN 560
540  HPLOT X,0 TO X,159
550  RETURN
560  GOTO 480
```

Listing 2. Program used to analyze the data.

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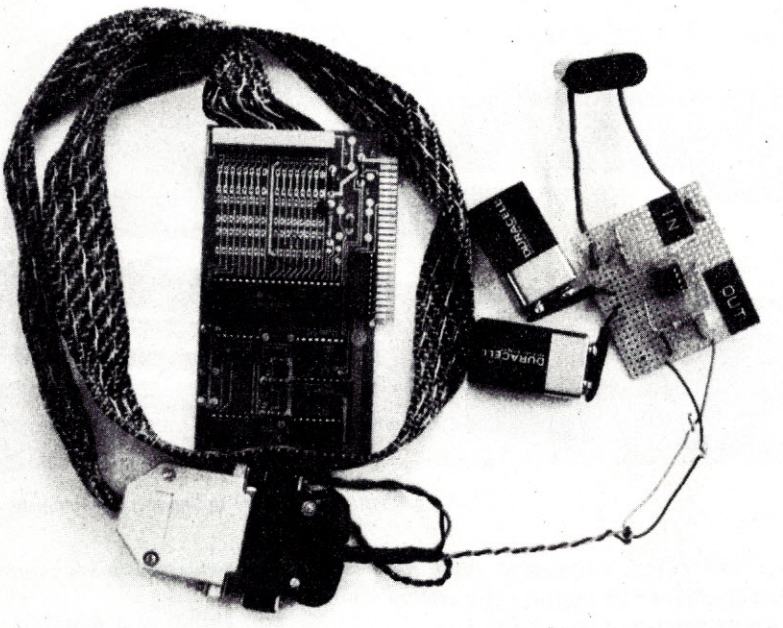

Photo 2. Amplifier board with A/D converter.

for analyzing the data. Statements 30 through 80 read the data from the specified file. Statements 90 through 140 plot the data on the Apple high-resolution screen. Using the paddles, the operator defines with a flashing cursor on the screen the range of data to be selected. Statements 450 through 470 define the cursor shape, and statements 480 through 550 draw the cursor on the screen and then delineate the range of the data selected. Statements 230 through 330 calculate the slope of a least squares line through the data. Statements 360 through 380 ask for further pertinent information, and lines 390–410 finally calculate the desired result of specific activity.

Conclusion

Use of the Apple for measurement of enzyme activity saves us time in the laboratory. Besides collecting the raw data, we can easily do data reduction, statistics, and report generation of results which are stored in the Apple. Furthermore, we can transfer our data and results to a large mainframe computer for other types of analyses by attaching our modem to the Apple.■

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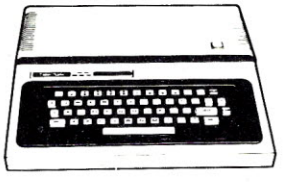

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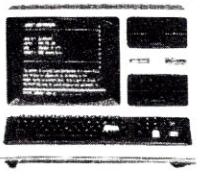

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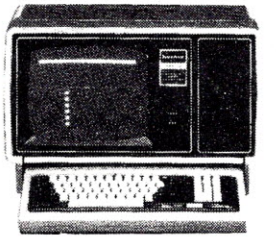

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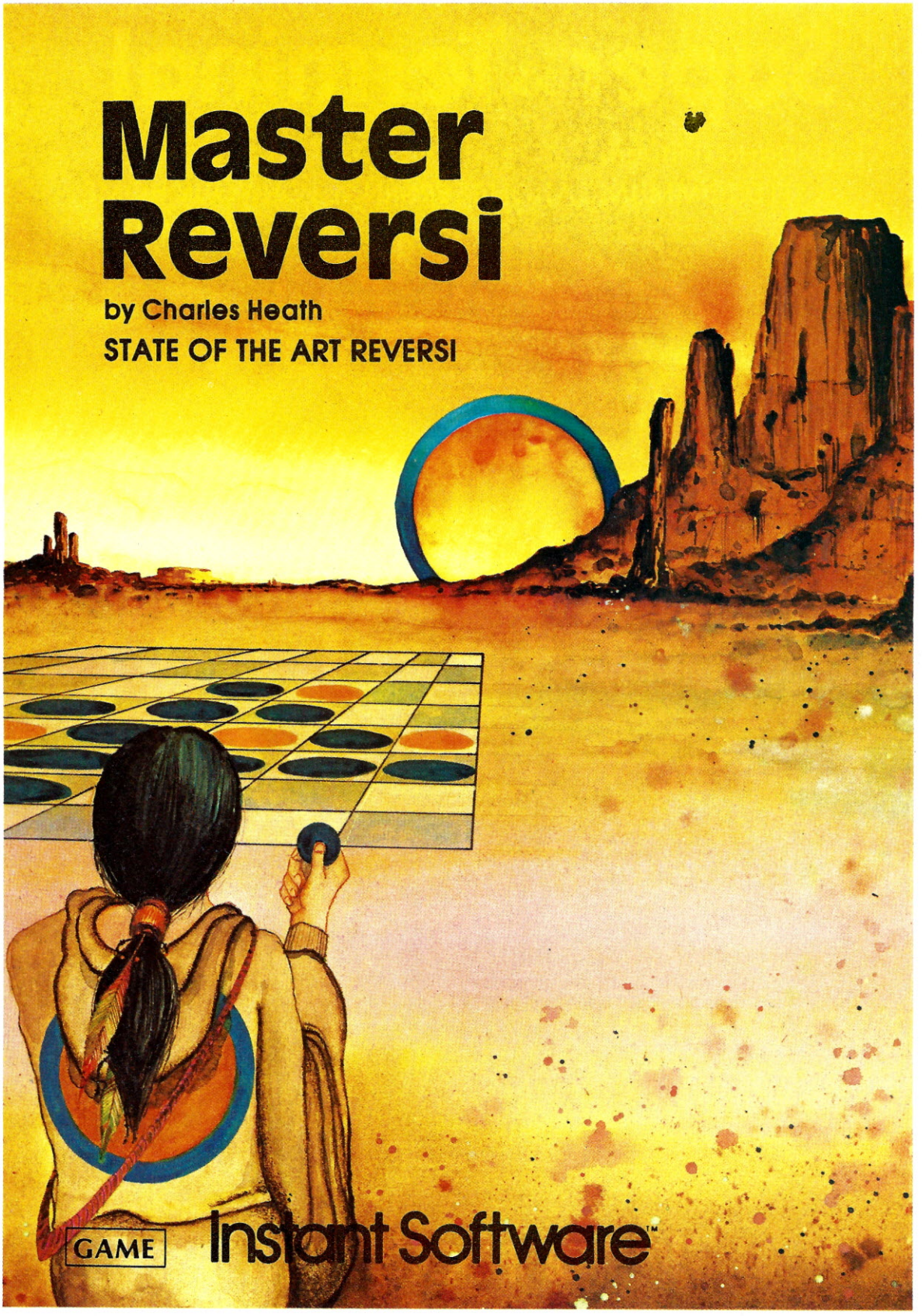

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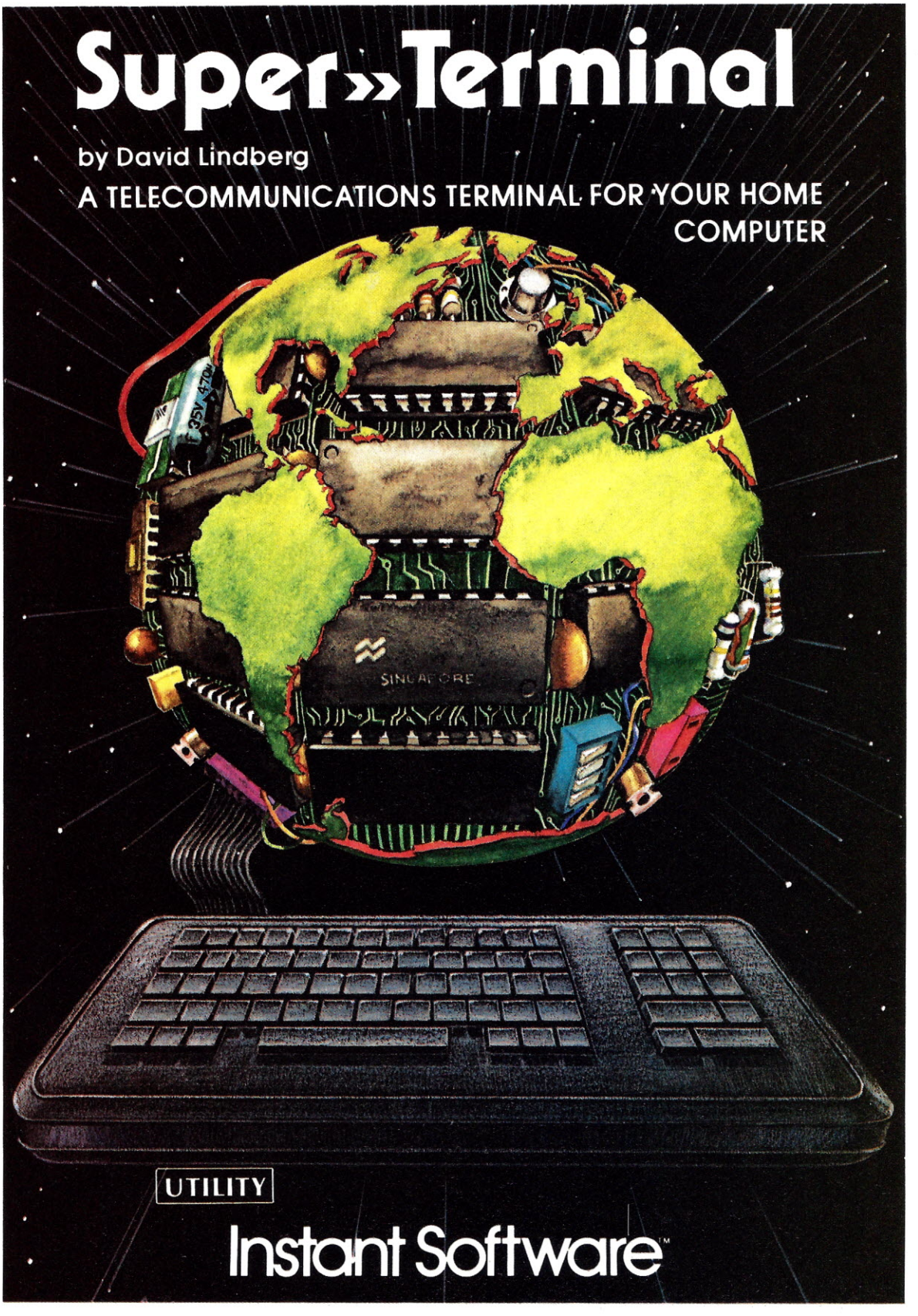

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(from page 59)

There are two fundamental problems with the study of these criteria in that article. First of all, much of the information is just plain false, and secondly, the most significant use of microcomputers in a large (or small) business application is not even considered.

Let's take a look at what I consider to be some of the misinformation. One expert points out that the typical 16-bit micro offers substantially less arithmetic precision that a 32- or 48-bit mini or supermini. "The run-of-the-mill 16-bit micro might offer seven digits of accuracy, which would be fine for payroll, but wouldn't do in the stress analysis of an aircraft element," he says. "The 48-bit Harris 800 supermini (which sells in full-system configuration for about $400,000) offers 20 decimal digits of precision, which can be a big help to an engineer."

Well, IBM's new Personal Computer offers 17-digit precision at a cost of under $3000. That's quite a price difference for three decimal places. (Also the Atari 800 and the TRS-80 in double-precision mode offer 16-digit precision.)

"Typically, the user can address 256 bytes of memory in the typical 16-bit micro.... This limits the size of the programs that can be used and the amount of data the program can compute on at any one time."

In a strictly technical sense that's absolutely true. Minis can directly address millions of bytes of memory. But with a good disk operating system (especially using hard disks) and good I/O programming, a micro can handle the same applications and the same amount of data with some time difference and with a huge cost difference.

A mini manufacturer is quoted as saying, "One of the biggest differences between a micro and a mini is that today's micros have very limited capabilities.... Minis, on the other hand, are inherently more flexible and generally expandable in terms of software migration to bigger systems." Another key factor, he says, is that minis have a friendly operating system and the user can readily run multiple applications.

Granted, no single micro has the capabilities of a good mini—but in many applications a system of micros can offer the same capabilities as a mini at a significant cost difference. Such micro systems can be just as flexible and expandable as a mini. And micros, just as minis, have friendly operating systems and can run multiple applications (see, for example, "Multiprocessor or Multitask" by Ken Barbier in the June 1981 *Microcomputing*, p. 34).

Another mini user quoted in Seaman's article says, "If I wanted to build a flight simulator for a Boeing 747, there is no micro or micro software that can handle the algorithms involved."

True. If I had to build a Boeing 747 flight simulator I too would want to use a mini (though, in fact, a system of micros could do a very respectable job), but how many businesses need a computer system with the capability to build a flight simulator for a Boeing 747? Also, you can buy, off the shelf, flight simulators for smaller aircraft that run on small micros.

A system of micros can offer the same capabilities as a mini at a significant cost difference.

"General Automation's (Anaheim, CA) Nocode software system permits development of applications software in a much shorter time and with a smaller staff. Nocode runs on GA's Instacode computer system.... Nocode will not run on microcomputers."

Nocode sounds like a fine system that does the same job as software like Pearl II and The Last One, which run on a variety of microcomputers. By the way, the Nocode system sells for $40,000 to $150,000—that's two to three decimal places of difference from the cost of the micro software.

This is only an indication of the misinformation that the computer customer has to sift through. Whether it results from ignorance of what micros can do, or from a desire to sell more costly products for higher commissions, is an open question. Let the buyer beware. The second problem with Seaman's article is one of omission. There is no discussion of the use of microcomputers in a networked environment with either a mini or larger micro as a system host.

A network of microcomputers, which may or may not include a mini, can be the ideal solution for many applications. It is an alternative that renders most of the mini-vs-micro arguments moot. If networking is brought into the discussion, there is virtually no difference between mini systems and systems of micros except, possibly, price. The cost of a micro network in which the micros can also serve as terminal work stations for a mini would actually be more costly than a conventional mini/terminal system, but the differences in computing power, number of possible work stations and productivity could well be worth the difference for very large applications. (For more information on networking see Brandt and Bodner's article on distributed intelligence networking and the Oct. 1981 issue of *BYTE*.) But for most applications networking will present a significantly less costly alternative.

Networking also offers a different perspective on the questions of service and down time. The good mini manufacturers by and large have excellent service organizations. Many micro manufacturers are working to catch up. But use of a network greatly diminishes the significance of the service and down-time issues. Put quite simply, if one computer in a network is down the entire system is not brought to a grinding halt. The others can, in the worst case, still be used as stand-alone systems. Some power may be lost while service or replacement is carried out, but some production can continue. This makes a network a truly attractive alternative to either a mini or a micro single-computer system that is completely down when the one processor is down.

Minicomputers are excellent machines and indispensable for many jobs—it would be foolhardy to argue otherwise. But there are a significant number of applications where micros and networking are the answer. Micros will not completely replace minis, just as minis have not completely replaced mainframes. The propagation of misinformation about what different systems can and can't do has to be harmful to the entire computer industry in the long run (and it isn't helping faculties to convince their administrations of the need for a variety of equipment to best prepare their students for work in that industry.■

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Radio Shack's gamble on the 6809 over the Z-80 pays off in a full-featured Color Computer at a low price.

Changing Chips In Midstream

By Michael A. Wolf

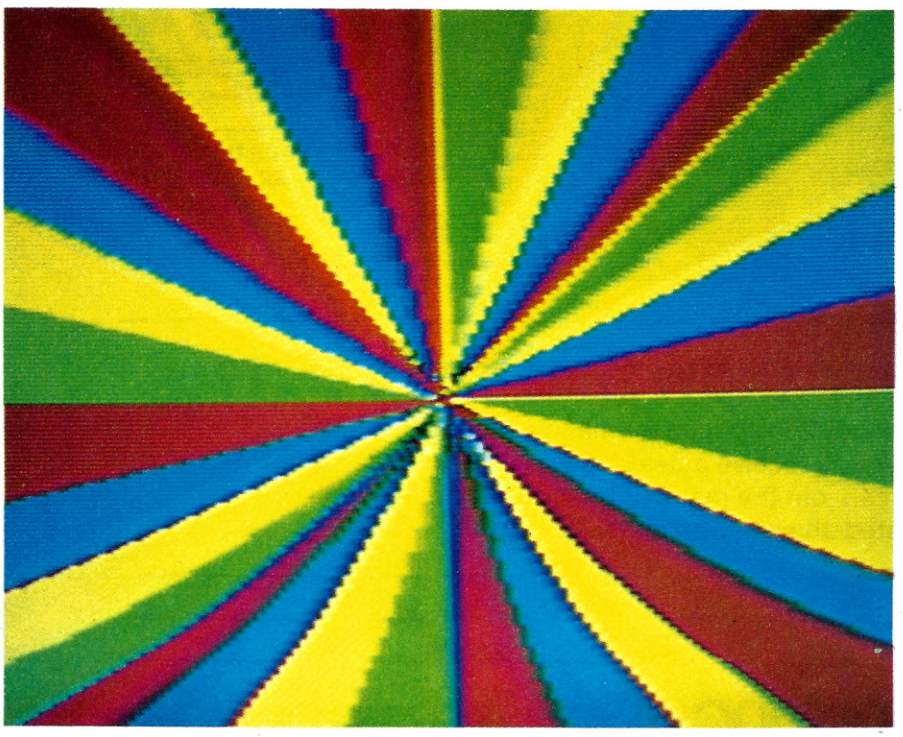
If you're like me, a dyed-in-the-wool 68XX user, you've been wishing a big company would select a 68XX microprocessor for a low-cost, serious home computer. You've been gritting your teeth every time someone announces a new 6502 or Z-80-based product.

Well, Radio Shack has done it—their TRS-80 Color Computer has a 6809 microprocessor. Not only that, but look at these features: color graphics, RS-232, joystick and cassette interface, sound, 4K bytes of programmable random-access memory (RAM) expandable to 16K and an 8K byte read-only memory (ROM) BASIC. All for $399. I bought it on the spot and took it home.

The Color Computer comes in a 13¾ by 14¾ by 3½ inch package weighing about five pounds. It has a 53-key keyboard, and displays 16 lines of 32 characters on a standard TV set. A slot in the right side accepts a plug-in ROM pack for prepackaged programs. If they don't suit you, you can write your own, using the excellent Microsoft BASIC provided.

Also included are a user's manual, a learner's guide to Color BASIC (as good or bad as the TRS-80 Level I book) and a quick reference card listing all the commands in the BASIC.

I hooked it up to a TV, using the supplied cable and antenna switch, and started running some sample programs. My first impressions were favorable. The keyboard takes some getting used to—it feels different from a regular keyboard—but it isn't bad. My old TV took some adjusting to get a good display, but when properly set up, it was quite satisfactory, giving vivid colors and nice black-on-green characters. The standard graphics are coarse at low resolution (64 by 32 pixels), but finer resolution (up to 256 by 192 pixels) is possible with 16K machines and Extended BASIC.



Color Computer screen displays using Extended Color BASIC. (Photos by Harold Nelson.)

The Package

About this time, curiosity got the better of me and I opened the case to see how they could sell so much for so little. What I found is an example of how large-scale integrated (LSI)

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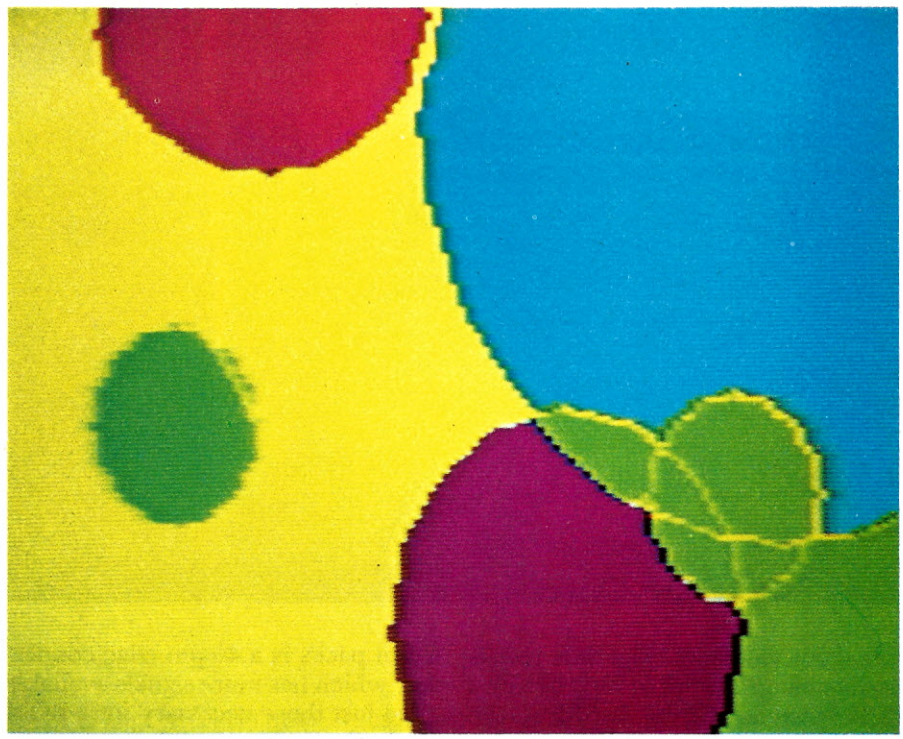
circuits have simplified computer design in the past few years. Not counting the power supply, the Color Computer has just 23 integrated circuits (ICs). By comparison, a TRS-80 Model I has about 80 ICs.

The Color Computer is based on three main chips. One is the processor itself, a 6809E (the E means external clock). Another is the 6847 video-display generator (VDG) chip. It contains nearly all the circuitry necessary to interface with the TV. The other is a 74LS783 synchronous-address multiplexer (SAM), which is a combination clock generator, dynamic-RAM controller and memory mapper.

In addition to these LSI chips, there are eight RAM chips (4027s for the 4K machine, 4116s for the 16K version); two 6821 parallel-interface adapter (PIA) chips, which handle most of the I/O; and a single 68364 ROM containing the 8K Color BASIC. Also included is a handful of support chips. The power supply occupies about one-third of the single circuit board, and the computer section of the board is enclosed in a metal shield to conform to the Federal Communication Commission's radio frequency interference standards.

There are four jacks on the rear for two joysticks, a cassette recorder and an RS-232 interface. The RS-232 is a 600 bits-per-second (bps) interface suitable for a printer. Radio Shack offers software and a modem to make your Color Computer useful as a ter-



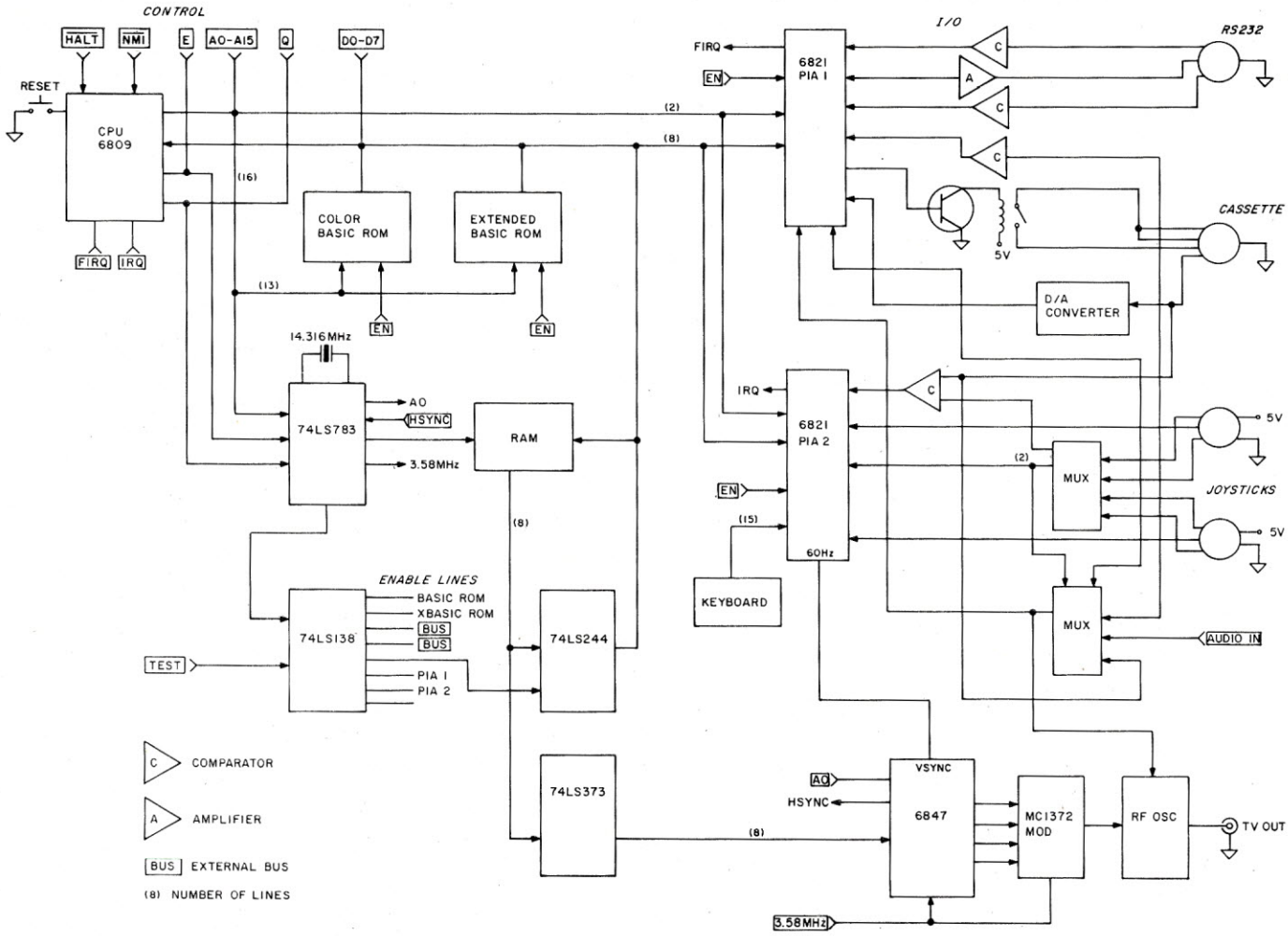
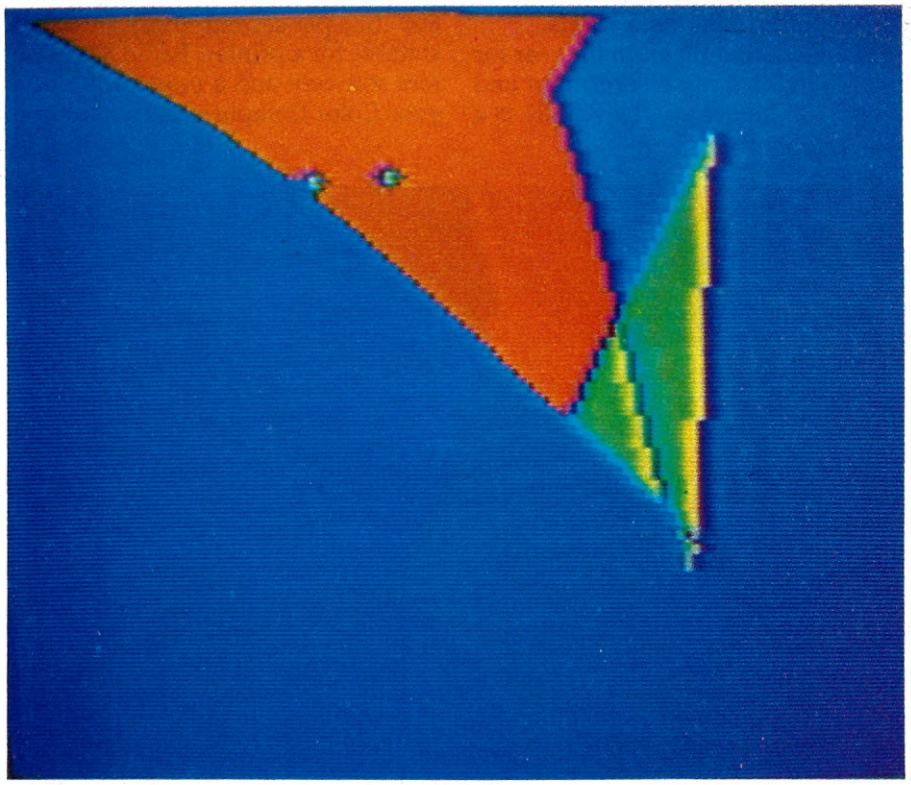


Fig. 1. Block diagram.



minal for videotext. The data rate is easily changeable up to 2400 bps by a POKE statement from BASIC.

The cassette port is a 1500 bps interface to a standard cassette recorder, with motor control, and it operates similarly to a TRS-80 Model I. It is three times as fast (and it doesn't have the dependence on volume settings that the earlier model had). It took only three tries to get the proper setting on my recorder (not the recommended model), and I've had few problems since then that weren't caused by me.

The video interface is a compromise. To get 32-character lines requires all the video bandwidth you can get out of a color TV through the antenna input. To get more characters would require a color monitor, which costs about twice as much as the Color Computer. Also, the VDG's character generator doesn't put out lowercase letters. They compromise by allowing lowercase in strings. The computer displays them in reverse video.

However, when you send them out the RS-232 interface, they go out as lowercase and are printed as such on a printer. This is better than a TRS-80 Model I, which had no provision for lowercase at all. Several modifications were designed to overcome this in the Model I, and it would be possible to modify the Color Computer too, since the 6847 allows for an external character generator.

The connector for the external program packs is a 40-pin edge connector, which has more signals available than just those necessary for a ROM pack. Radio Shack did their homework on this. Not only are all the address, data and important control lines available; there are two decoded select lines for programs and I/O.

Also, a signal on one of the pins lets you disable any of the internal resources and substitute external I/O or memory anywhere in the address space. This allows such tricks as overlaying special routines on top of the BASIC, adding external RAM anywhere in memory or substituting an external I/O port for the one that's in the box. It looks like they planned for a future expansion bus.

Control may be easily transferred to your own machine-language routines upon interrupt by poking a jump instruction at the appropriate memory location.

How Does It All Tie Together?

First, look at the block diagram in Fig. 1. The microprocessor and VDG share the RAM, using a technique called interlacing. During part of a machine cycle, memory is accessed by the video generator, and during the rest of the cycle by the processor. This is made possible by the consistent machine cycle length of the 68XX family of processors. Each machine cycle has two memory cycles. The first provides the data for the video generator; the data is latched halfway through the cycle. The second access is for the processor. All this juggling is handled by the SAM.

The SAM has provisions that let you select either graphics mode, the base address of the display memory, the type of memory used (up to 96K is possible) and even select between two types of memory maps.

The joysticks use a six-bit digital-to-analog (D/A) converter and a comparator to generate numbers from 0–63 proportional to the voltage on the joystick connectors. This could be used for a number of things in addition to joysticks. The voltage must be between 0 and +5 V.

VDG

Let's look further at the 6847 video display generator (VDG). The VDG has two alphanumeric, two semigraphics and eight full-graphics modes.

- A/G (alpha/graphics) switches from alpha/semigraphics mode to full-graphics mode.
- A/S (alpha/semigraphics) switches from alpha to one of the two semigraphics modes.
- INV causes the alpha display to be reversed (green-on-black or black-on-green).
- INT/EXT lets you use an external character generator in the alphanumeric mode, and switches between the two semigraphics modes.
- GM0, GM1 and GM2 are the full-graphics control lines, and control the various graphics options, from 64 by 32 pixels (picture elements) to 256 by 192.
- CSS, color set select, switches sets of graphics colors and background color for the graphics modes with limited color selections.

The machine comes up in the alpha/semigraphics mode, and is in semigraphics 4 when in semigraphics. Each character space is divided into four pixels, which can either be black or one of eight colors, but the whole character space must be the same color. A POKE 65314,16 switches to semigraphics 6, which limits you to two sets of four colors but gives you 64 by 48 pixels. These are more nearly square, and thus make graphics look better. However, Set, Reset and Point don't work in this mode. It also switches to external character mode, so alphanumerics are not usable.

The graphics modes are also available but require more memory than BASIC allows in a 4K machine, so are limited to a 16K box. They also re-

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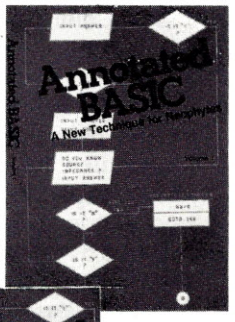

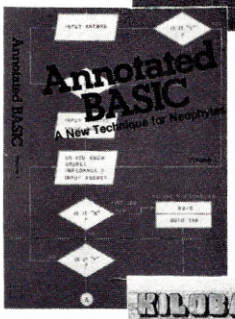

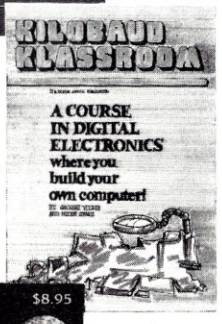

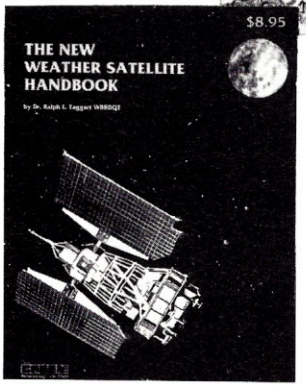

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quire that the SAM be set up for the proper mode by writing to the control addresses in the proper pattern for the selected mode.

BASIC

Color BASIC is an 8K Microsoft BASIC which compares closely with TRS-80 Level II BASIC, with special instructions for the color, sound and joystick functions, plus a few enhancements. Since Level II is 12K BASIC and Color BASIC is only 8K, there are also some functions not present in Color BASIC. But it shouldn't be too difficult to adapt programs from one system to the other.

Missing in Color BASIC are the AUTO, TRACE and EDIT functions, which makes entering and debugging programs more difficult. Only one cassette is supported, but the cassette control takes eight-character file names and includes the SKIPF instruction, which will skip files on a cassette and go to the end of the last file on the tape to add new files. CLOADM permits loading machine-language files with an offset, if desired.

SYSTEM is replaced by EXEC (a), which allows going to a machine-language program at address (a). PRINT USING is missing, as are the DEF functions and the error traps. In the string functions only STRING$ is missing in Color BASIC. The nine-digit floating-point arithmetic is a compromise between Level II's six-digit single-precision and 16-digit double-precision arithmetic. Missing are all the instructions relating to defining variable types.

Most common statements are present in standard Color BASIC. Also available is Extended Color BASIC, which includes high-resolution graphics, complex sounds, extensive graphics commands, a real-time clock, program editing, user-defined functions and machine-language routines, plus most of the statements missing in Color BASIC. It costs $99.

You can also buy several canned programs, including chess, checkers, music composing, personal finance, pinball, a diagnostic for ROM and software to convert the Color Computer to a terminal. Compatible hardware includes a printer, a telephone modem and joysticks.

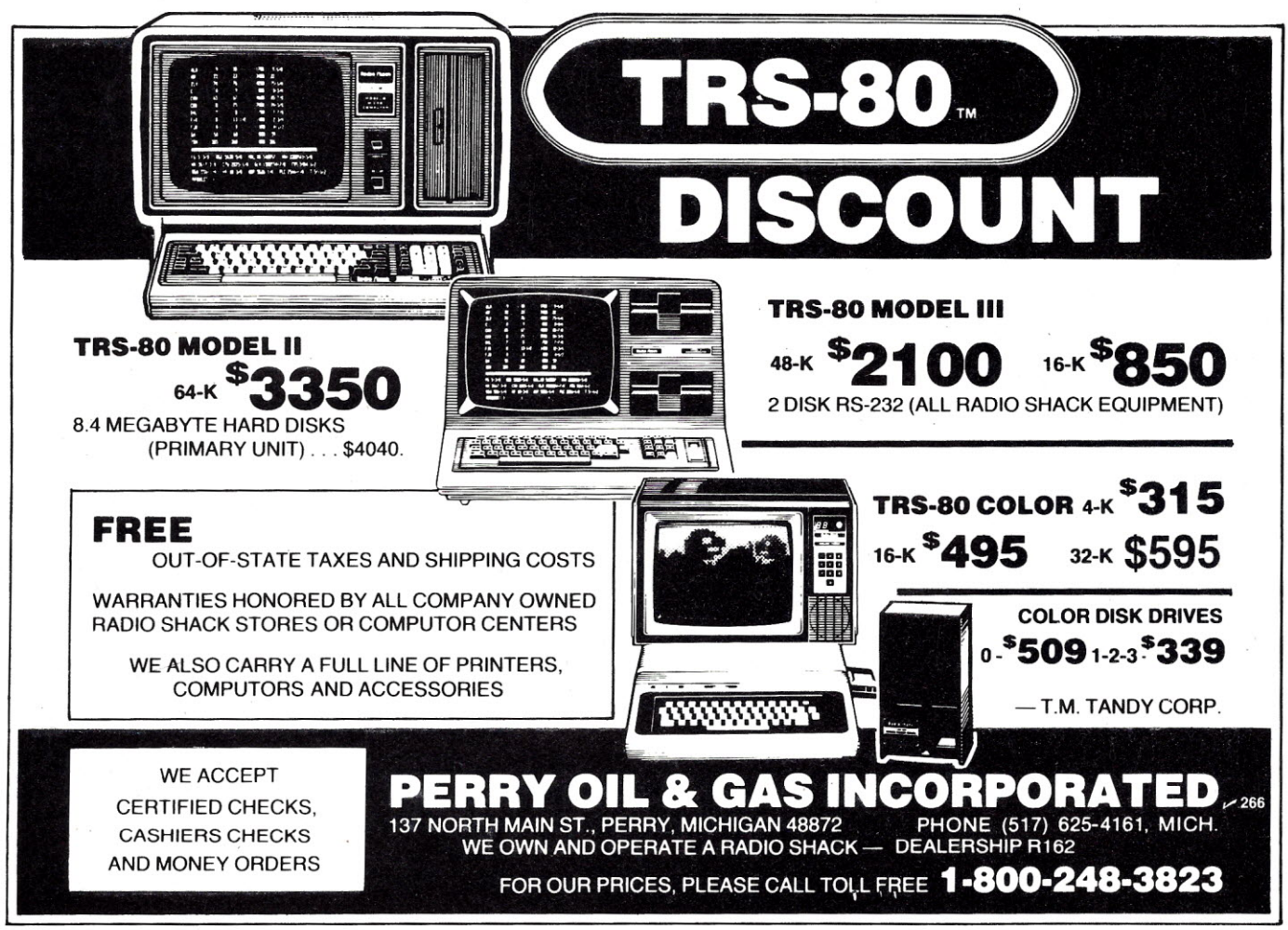
RAM expansion to 16K bytes is easily done by replacing the 4K RAM chips with 4116s and changing two jumpers clearly labeled on the board. These are available from several sources for less than $30.

RAM expansion beyond 16K is possible but not as easy. You can get 32K by adding another set of 4116 RAMs—the problem is mostly mechanical. Obtaining 64K is possible with greater difficulty, as some software has to be changed. Kits to enable these expansions are available from Atomic City Electronics, 3195 Arizona Ave., Los Alamos, NM 87544.

Conclusions

The Color Computer is a low-cost, full-function computer suitable for most general-purpose computer use. Although limited by the restrictions of the display for some uses, it is well-suited for video games, and is easily expanded for more memory and I/O devices.

Radio Shack says they will soon offer a disk, and I know of accessories being designed at several companies. So it looks like a good start for a nice system. And the low price should mean a lot of sales, and soon, a lot of software.■



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6504	8.45
6504A	9.30
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6512A	10.00
6520	4.40
6521	6.15
6521A	6.70
6522	8.75
6522A	11.70
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6532A	12.40
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15.0MHZ	Series
18.0MHZ	Series
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A PET computer and a Pioneer video disk player combine to open up a wide range of applications in the educational field.

A Computer/Video Disk Combo That Really Works!

By Paul Anderson and
Everett Q. Carr

People have been waiting for a practical video disk since they were first announced by Philips and RCA almost ten years ago. Film studios saw big bucks in marketing films that had already run in the movie houses and on TV. Computer manufacturers hoped for a cheap $10 crash-proof archival memory consisting of a billion and a quarter bytes of ROM. Some educators believed that the video disk was a critical element in the information technology revolution that would transform schools, maybe even eliminate them entirely.

To find out if this latter notion had any basis in fact, we built our own information transfer system. It consists of a 32K PET 2001 computer and an adapter that allows the PET to control the Pioneer video disk player (fig. 1). We have also developed software that controls the disk player. The result is that we have been able to construct an instructional program in which the student interacts with the computer and the disk on the player.

The first program is called Weather and uses an MCA-Discovision disk entitled "What Makes it Rain?" (#64-006). It costs just $9.95. The description that follows should allow anyone interested to duplicate the system and verify our test results as an example of computer-aided video disk instruction.

	Characteristics
Laser Illuminated/Optically Scanned	
1. Pioneer of Japan 2. Pioneer Electronics of the US Laserdisk VP-1000 3. MCA Discovision (IBM and MCA) 4. Magnavox (No Remote Control) 5. Sony of Japan 6. Philips of Holland 7. Thompson CSF of France (Disks not compatible with those of 1–6) Software: All except Magnavox Thompson CSF	All players have 1/2-hour and one-hour playing time per side, use a HeNe 1 MW gas laser, two-channel stereo (40 Hz to 20 Hz), have pushbutton controls, can operate single frame (freeze action), slow, fast forward and reverse and have picture frames numbered (1/2-hour only). The 1/2-hour versions operate at constant angular motion with disk rotating at 1800 rpm. The one-hour play time is obtained by changing disk rotation from 1800 rpm at the inside of the disk to 600 rpm at the outside of the disk, therefore operating on constant linear velocity for double play time. Thompson CSF uses transparent information coating and system refocuses to read both disk sides without turnover. Software unknown.
Needle in a Groove	
1. RCA 2. Zenith 3. CBS Software: RCA	The needle has a capacitor plate on its face forming a variable capacitor as a function of the disk groove variations with respect to the conductive vinyl base of the record. Needle is subject to wear and disk cannot be played continuously on a single frame. Disk grooves are 40× closer than on a hi-fi record.
Grooveless with Needle	
1. JVC of Japan 2. GE 3. Thorn/EMI of England Software: JVC	Needle position is servo-controlled and tracks an information band next to the signal band. There is needle wear, and continuous play on a single track may not be feasible.

Table 1. Video disk systems comparison.

The Computer/Video Disk System

The Pioneer video disk system is a superb piece of electronic and electromechanical wizardry. It uses a 1 MW HeNe gas laser to illuminate the video disk information tracks and has a 4002 internal microprocessor and a 4001 data processor for the logic and

Paul Anderson, an unpaid member of the planetarium staff, has been a student at Rensselaer Polytechnical Institute at Troy, NY. Everett Q. Carr is director of the Herkimer BOCES Planetarium (Herkimer, NY 13350) and responsible for its honors student programs and a microcomputer instructional program series that lends out computers.

control of 25 switching functions that affect the player operations. The electromechanical system not only takes care of vertical motion in the disk rotating at 1800 rpm, but also follows individual TV picture tracks 1.6 micrometers (63 microinches) apart. A full half-hour of TV contains 54,000 TV pictures (30 frames per second × 60 seconds per minute × 30 minutes per half hour).

Pioneer manufactures video disk players for Discovision Associates and Magnavox. Almost 11,000 of the Discovision players have been sold to General Motors and its car dealers. In single quantity, this player costs $3000. The big advantage is that a computer interface and connector are built-in. Another version packaged for Magnavox is supplied without an interface or remote control.

The Pioneer player with its remote control access has proved straightforward to adapt to computer control. The only exception is covered later. However, the Pioneer player is only one of four competitive video disk systems. All of them are incompatible, with differences much like those between cassette and magnetic disk recording systems of the leading manufacturers. For example, we cannot interchange tapes or disks among the three leading manufacturers. A comparison of the systems is given in Table 1. It should be obvious that the noncontact readout systems from Philips, Pioneer, Sony, Magnavox and MCA-Discovision, all of which have interchangeable disks, are superior for classroom and other instructional uses.

The chief reason for our preference of the noncontact systems is the wear-out mechanism. RCA uses a diamond stylus that contains a capacitor plate to sense signals in the record groove recorded on a 900 MHz carrier signal. The JVC scheme uses a sapphire stylus that has a capacitor plate but is servo-controlled to track signal information in a grooveless recording system. While there are no tests to confirm the data, the life of a diamond stylus is approximately 3000 hours, compared to 2000 hours for the sapphire stylus and 100,000 hours for the gas laser. The choice is therefore obvious.

But more than that, the MCA Discovision disks have each of the 30,000+ frames of "What Makes It Rain?" numbered, and they can be selected for display by remote control or with the built-in keyboard using a numeric keypad. The internal microprocessor is programmed to allow slow motion, fast scan, variable-speed scan and single-frame indexing, all in forward or reverse motion.

It is also possible to select an individual frame by number for freeze-frame viewing. There is no wear to the disk, because there is no disk contact for readout.

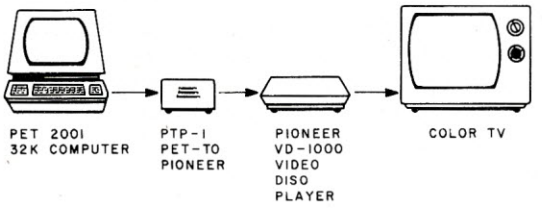

Fig. 1. A computer/video disk system.

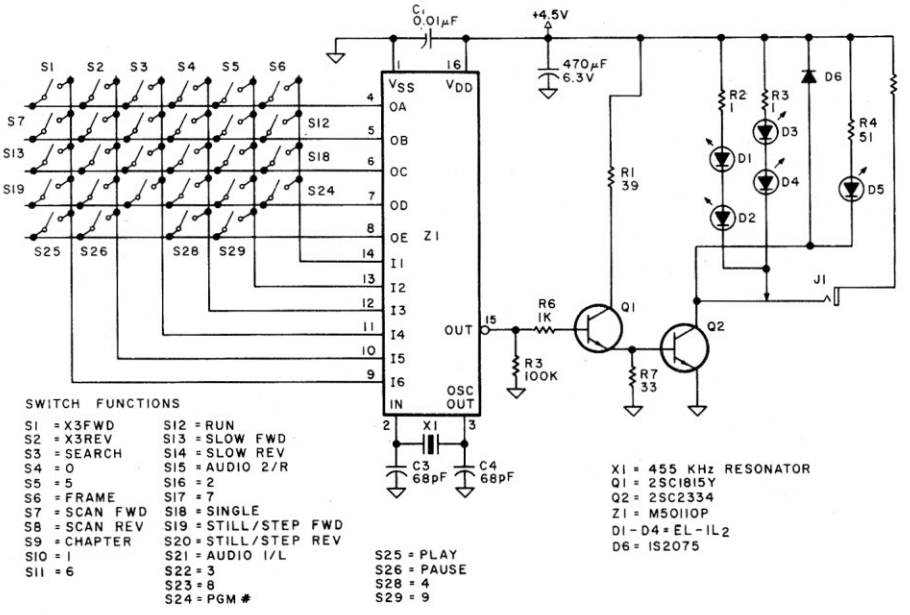

Fig. 2. RU-1000 Pioneer remote control. The switches S1 to S29 are the functional push buttons on the remote control, as the figure shows. The IC-1 appears to be a custom chip to convert switch closures to a chain of 38 kHz pulses as an output. The crystal XI is a 455 kHz piezo-ceramic resonator, used generally in AM radio IF stages to replace IF transformers. The transistors Q1 and Q2 are a Darlington-connected line driver. The remote control can be used as a wired unit by connecting an audio connector cable to J1. The diodes D1 to D4, however, are LEDs operating at about 9400 A, well into the infrared range. D6 is a visible region LED.

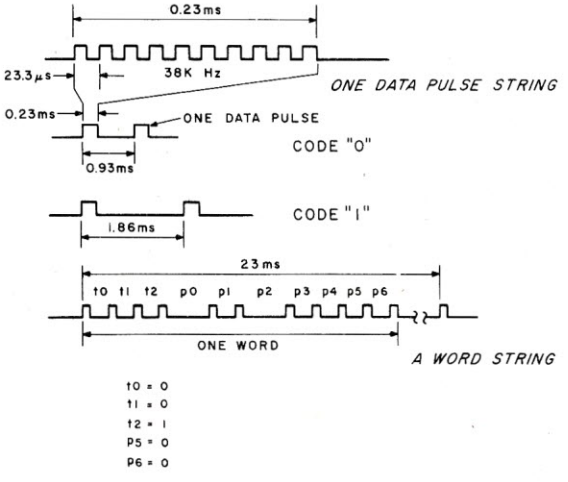

Fig. 3. Pioneer player control signals. One data pulse string is ten cycles of an approximately 38 kHz clock. The coding for a logical 0 is 0.93 ms, a short period between data pulse strings. The logical 1 is twice the logical 0 period, 1.86 ms. The word string delivered to the player is ten bits long; therefore it consists of 11 actual data pulses. Of the ten bits used, five bits are a fixed code; the remaining five bits can form up to a maximum of 32 commands.

Video Disk Adapter

Pioneer's remote control unit (RU-1000) was a parts bin for a new adapter between the PET and the disk player. The RU-1000 contains both a wired connection to control the player and an infrared wireless link. A schematic of the RU-1000 is shown in Fig. 2. IC-1 is apparently a custom MOS chip which scans the keyboard of the RU-1000 and outputs a coded 38 kHz chain corresponding to up to 30 different switch closures. The pulse chain sequences are shown in Fig. 3.

In our adapter, the switch closures are simulated by the two CD 4051 circuits, IC-2 and IC-3, which accept the eight-bit inputs from the PET user port. The PTP-1 PET to PIONEER adapter schematic is shown in Fig. 4. The circuit board layout is given in Fig. 5. Power for the adapter is taken from the second cassette source, which is rated for at least 200 mA; the adapter draws less than 50 mA.

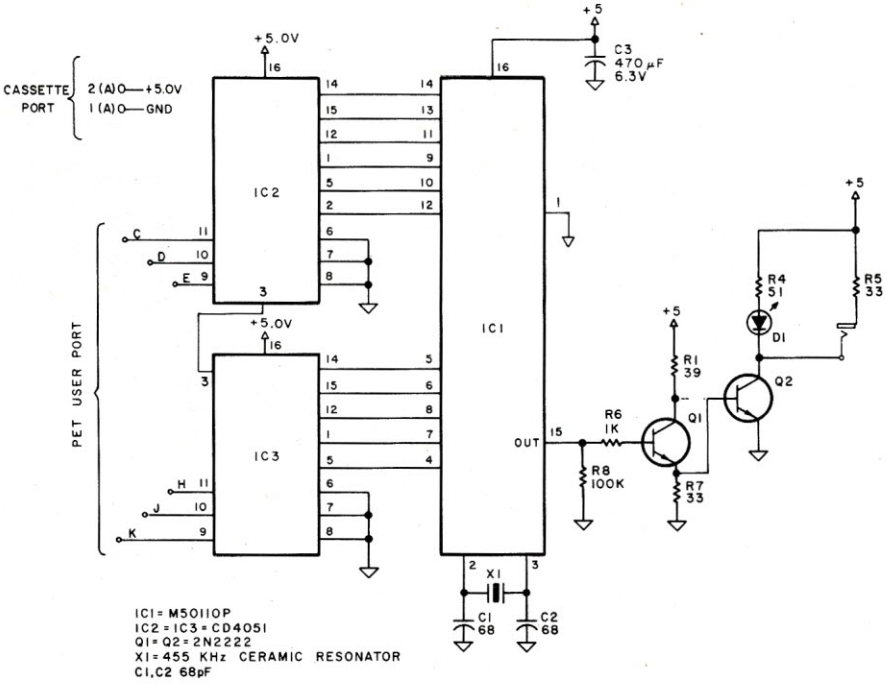

Fig. 4. PET to Pioneer adapter. In our adapter the IC-1, M50110P, was removed from the original remote control because the separate IC was not available from Pioneer. The infrared optical link was eliminated and only the wired link was used. The reason was the IR LEDs have peak current requirements of nearly 1 A, and the power we used was the PET (200 mA maximum) second cassette 5 V source. IC2 and 3 are multiplexers which, to the custom IC-1, look like switch closures which, on the input to the PET, are logical load for the user port VIA.

The Video Disk Driver Program

The Video Disk Driver program was written to exercise a Pioneer disk player regardless of what disk is in place on the player. It allows, for example, the command to the player S1950 in response to the program query COMMAND STRING-->|; the player searches for TV picture frame number 1950 and waits, with frame 1950 displayed continuously. An alternative command of S1950S would command the player to search for TV picture frame 1950 and run the player forward from that frame.

The Weather Instruction Program

For the Discovision disk "What Makes It Rain?" we have given an interactive program, Weather, which uses some 3600 frames or about two minutes of disk play time. The brief program contains four questions from lines 1010–1260, 2020–2041, 3010–3270 and 4010–4250. In each question, the student has three possible answers. The computer responds positively to a correct answer, lets the student try again if the response is wrong or reviews the video information before trying the question again.

The review of the video is controlled by the specification of the variable Q8, and a delay loop beginning at line 13000 determines how long the player is allowed to operate. A calculation in line 13030 accounts

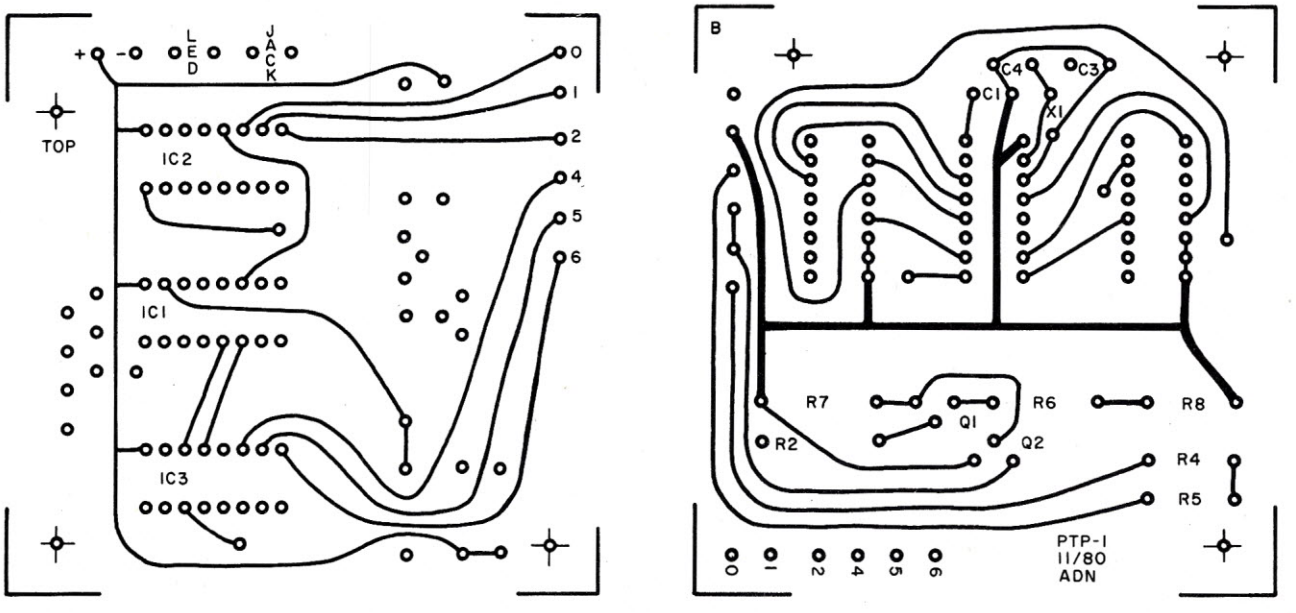

Fig. 5. Full-size PTP-1 printed circuit board layout.

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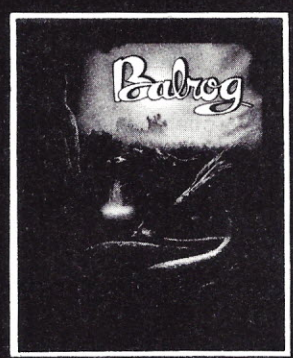

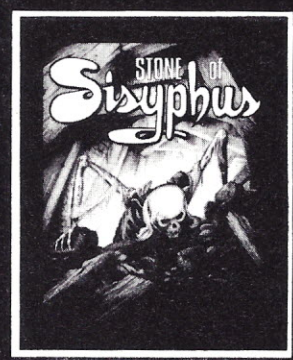

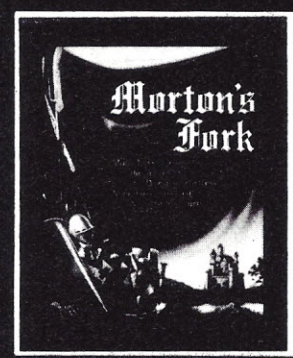

BALROG

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STONE OF SISYPHUS

The STONE OF SISYPHUS carries you to a 'thinking man's" dungeon, wherein you must apply your skills to effect survival and to realize your goals. This is an unfriendly subterranean world populated by hideous monsters, and dripping with fabulous treasures — the latter enticing you to face the former! Your survival hinges upon hard intellect, as opposed to the wispy uncertainty of chance, so be prepared to draw deeply from your intellectual reservoir! And — the responsiveness of the program to the individual qualities of your character make this grand adventure frustratingly enjoyable for hundreds of hours before all of its elusive secrets can be unlocked!

MORTON'S FORK

The third entry in the Maces & Magic series, MORTON'S FORK transports you into a world bereft of natural laws — a realm populated by magical beings and strange creatures. The scenario is set within the confines of an ancient wizard's fortress. Through your keyboard input, you equip your warrior with armor, weapons, and gold, as well as with desirable personal attributes. Only then will you be able to face the dangers of MORTON'S FORK! Features include multiple skill levels and a comprehensive manual describing the colorful Maces & Magic world.

MACES & MAGIC are fantasy adventures involving you and your computer. Armed only with your wits, a microcomputer, and the software provided, you can become the hero or the meal your destiny dictates. You create a character, equip him (or her) with suitable weapons and armor, and enter the dungeon in search of fame and fortune. Neither is particularly easy to obtain.

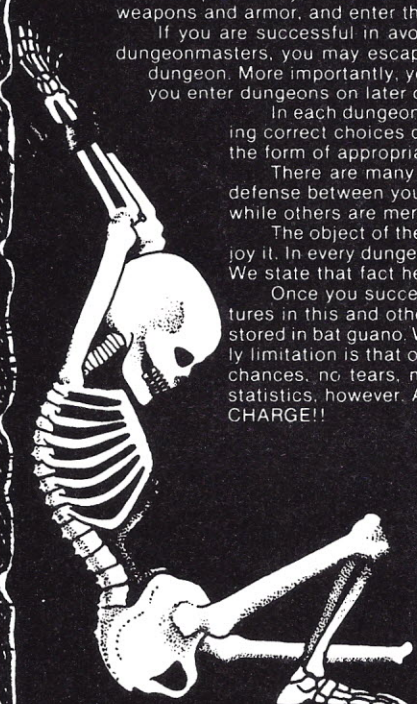
If you are successful in avoiding or conquering the various monsters, traps, enchantments and illusions set by our nefarious dungeonmasters, you may escape with riches and glory. Your name and deeds will be recorded for posterity in the records of the dungeon. More importantly, you'll be alive. You may then use the same character in his more experienced and wealthy form when you enter dungeons on later occasions.

In each dungeon there are random events which occur, but in the vast majority of cases the skill of the player in making correct choices determine the outcome of the game. The majority of instructions are furnished within the program in the form of appropriate prompts.

There are many ways to meet an untimely demise in the dungeon. Monsters and such are just one of the lines of defense between you and the treasures stored there. Various traps await the unwary (and the wary too). Some are lethal, while others are merely unpleasant or inconvenient. It pays to be suspicious. Beware of orcs bearing gifts.

The object of the whole exercise is not just to fight the monsters and collect treasure. You have to get out alive to enjoy it. In every dungeon there is at least one exit. It is possible to escape from each and every dungeon with a whole skin. We state that fact here because players often believe this not to be true. We really aren't out to get you. Not really.....

Once you successfully exit from the dungeon you will have an opportunity to save your character for further adventures in this and other dungeons. Your treasures will be converted to their gold equivalent and your weapons and armor stored in bat guano. When you start another adventure, you may call up your experienced character for another trip. The only limitation is that once a character is killed, he may re-incarnated three times; after that, he is gone forever. No second chances, no tears, no breast beating. Gone. Kaput. Finished. You will have the distinction of adding to the dungeon statistics, however. A sort of second hand immortality in recognition of a nice try. No glory or cash though. CHARGE!!



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for search time lags that may be a function of our particular Pioneer player dynamics. We would have preferred to be able to advance the disk to a specific frame. The calculation is necessary because there is no data line available from the player which indicates the frame number. Undoubtedly, it is available internally at the microprocessor but it would be necessary to open the player and modify the circuits. The system shown seems accurate within a few frames over short time intervals. Moreover, it can be made precise with a small amount of effort.

The program uses about 15,380 bytes of RAM. It could be compressed into fewer bytes with a little effort.

We have used simple graphics that often hint to the children the correct answer. Our third-grade visitors to the planetarium seem pleased with what they see and hear. When the correct answer is given, it is reinforced visually with a printed text of the words of the disk monologue. A child will receive several reviews of new words. This is especially helpful when third-grade children are exposed for the first time to terms like precipitation, rendezvous, evaporation and reservoirs.

Authoring a Disk Program

Authoring a disk program means a systematic approach to developing an instructional program. This, of course, involves both the video disk and the computer program. Of necessity, we did not create an original video disk. That cost was well beyond our own resources. Our project therefore involved construction of a useful computer instruction around an available disk.

Within that constraint, the major task was to use the disk player as an audiovisual editing machine with the weather disk. Both frame numbers and the monologue were recorded manually, using the disk player's regular remote control. This is a working script from which it is possible to isolate factual information, the individual concepts and principles involved. This is an iterative process. It took a half-dozen or more passes and uncounted isolated playbacks. However, we became more proficient with time.

The method we used in the computer program development was to design two program modules. The first was the Quiz Module, in a multiple choice format. The second was the Disk Driver module. The combination of the two modules is a practical approach to an authoring system using available low-cost disks and the common language resident in the popular microcomputers, BASIC.

The PET, with its user port so accessible and easy to program, is a powerful tool in this enterprise. For those not interested in a construction project, ADN Co. (62 Benedict Ave., Ilion, NY 13351) has an adapter that works with the PET. It can also be supplied for the Commodore VIC-20.

Test Results

Two groups totalling 137 third-grade students were exposed to the first two minutes of the video disk "What Makes It Rain?" Sixty-seven percent of the first class of 74 students and 72 percent of the second class of 73 answered test questions correctly. These children were attending our regular planetarium laboratory class about weather. The results were 12 percent and 14 percent higher than with a conventional teaching session consisting of a chalkboard and lecture.

The combination of computer and video disk appears to be superior to conventional methods. The work continues. We hope interested teachers will attempt to duplicate the experiments.■

```
 1 D9=50
 2 REM VIDEO DISK DRIVER WRITTEN
 3 REM 10/30/80 BY PAUL D. ANDERSON
 5 REM COMMAND SUMMARY AT LINES
 6 REM 13000-14000
 10 DIM TX(15)
 20 GOSUB 12000
 30 INPUT "COMMAND STRING-->";CS$
 35 PRINT
 40 GOSUB 10000
 50 PRINT:PRINT
 60 GOTO 30
 10000 FOR Q1=1 TO LEN(CS$)
 10010 Q2=ASC(MID$(CS$,Q1,1)):GOSUB 11000
 10020 NEXT
 10030 RETURN
 11000 IF Q2>57 OR Q2<48 THEN 11020
 11010 Q3=TX(Q2-47):GOTO 11060
 11020 IF Q2>72 OR Q2<70 THEN 11040
 11030 Q3=TX(Q2-59):GOTO 11060
 11040 Q3=0
 11045 IF Q2=80 THEN Q3=TX(14)
 11050 IF Q2=83 THEN Q3=TX(15)
 11060 PRINTCHR$(Q2);:POKE 59471,Q3
 11070 FOR J=1 TO D9 : NEXT
 11080 POKE 59471,0
 11090 FOR J=1 TO D9 : NEXT
 11100 RETURN
 12010 DATA 86,22,38,70,54,82,18,34,66
 12020 DATA 50,81,52,69,53,83
 12020 FOR J=1 TO 15:READ TX(J) : NEXT
 12030 POKE 59459,255
 12040 RETURN
 13000 REM   ****  COMMAND SUMMARY  ***
 13010 REM NUMBERS "0"-"9"
 13020 REM SEARCH  "S"
 13030 REM PAUSE   "P"
 13040 REM PLAY    "G" (GO)
 13050 REM FRAME   "F"
 13060 REM STILL   "H" (HALT)
```

Video Disk Driver program.

Weather interactive video disk/computer program.

```
10 GOSUB 12000 : REM INITIALIZE VIDEO
20 REM DISK STUFF
85 PRINT"□":POKE 59468,12
90 PRINT: PRINT: PRINT:PRINT:PRINT
1000 PRINT"□":POKE 59468,12
1010 PRINT"
1020 PRINT"
1030 PRINT"
1040 PRINT"
1050 PRINT"
1200 PRINT"WHAT ARE CLOUDS?" :PRINT
1210 PRINT"(1) CLOUDS ARE MADE OF ICE PARTICLES":PRINT
1220 PRINT"(2) HUGE RESERVOIRS OF"
1230 PRINT"    AIRBORNE WATER":PRINT
1240 PRINT"(3) CLOUDS ARE DUST PARTICLES"
1250 PRINT"    HELD UP BY COLD AIR AND WIND.":PRINT
1260 PRINT"TYPE 1, 2 OR 3;
1270 INPUT AA
1280 IFAA=2 GOTO 1700
1290 PRINT"□":PRINT:PRINT:PRINT:POKE 59468,14
1300 PRINT"SORRY,THAT IS INCORRECT":PRINT
```

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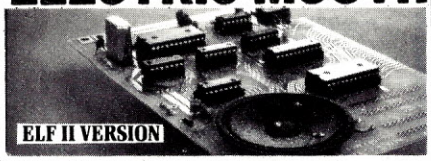
Listing continued.

```
1310 PRINT"WOULD YOU LIKE TO TRY AGAIN?
1320 PRINT"TYPE Y OR N":PRINT
1340 INPUT AB$
1350 IFAB$="Y"THEN 1000
1500 PRINT"WOULD YOU LIKE TO REVIEW THE VIDEO":PRINT
1510 PRINT"TYPE Y OR N":PRINT
1520 INPUT AC$
1530 IF AC$="N" THEN 50000
1550 K=0
1570 CS$="S1950S":GOSUB10000:FORI=0TO2000:NEXT
1575 CS$="G":GOSUB10000
1580 Q8=120:GOSUB13000
1610 GOTO 1000
1700 PRINT"□":POKE 59468,14:PRINT:PRINT:PRINT
1705 K=0
1710 PRINT"GREAT THAT'S CORRECT":PRINT:PRINT:PRINT
1800 PRINT"CLOUDS HUGE RESERVOIRS OF AIRBORNE WATER."
1801 CS$="S1950S":GOSUB10000:FORI=0TO2000:NEXT
1802 CS$="G":GOSUB 10000
1803 Q8=120:GOSUB13000
1810 FOR I=0TO2000:NEXT:PRINT:PRINT
1820 PRINT"COME ON NOW BACK TO WORK":FOR I=1 TO 3000:NEXT:PRINT:PRINT
2000 PRINT"□":POKE 59468,12
2010 PRINT
2020 PRINT"     *      *            . .
2021 PRINT"
2022 PRINT"
2023 PRINT".●   .      ___.
2024 PRINT"          /   \
2025 PRINT"         /     \
2026 PRINT"        |       |
2027 PRINT"        |  EARTH|
2028 PRINT" *    . |       |  .      *
2029 PRINT".       |       |      .     ..
2030 PRINT"         \     /  .   *
2031 PRINT"          \___/●          .. *
2032 PRINT"    .           .   .
2033 PRINT:PRINT
2034 PRINT"    WHEN THE EARTH BEGAN,
2035 PRINT"    BEFORE THERE WERE OCEANS,
2036 PRINT"    WHERE WAS ALL THE WATER ?
2037 PRINT:PRINT
2038 PRINT"    (1) IN THE ROCKS OF EARTH
2039 PRINT"    (2) IN CLOUDS AROUND EARTH
2040 PRINT"    (3) IT WAS NOT FORMED YET":PRINT
2041 PRINT"TYPE 1, 2  OR 3":INPUT B
2042 IF B=2 THEN2800
2300 PRINT"□":PRINT:PRINT:PRINT:PRINT:POKE59468,14
2310 PRINT"OOPS! THAT'S NOT RIGHT. TRY AGAIN?":PRINT
2320 PRINT"  TYPE Y OR N, PLEASE"
2330 INPUT BB$
2350 IF BB$="Y" THEN 2000
2400 PRINT"WOULD YPOU LIKE TO SEE THE VIDEO AGAIN?":PRINT
2410 PRINT"  TYPE Y OR N, PLEASE."
2420 INPUT BC$
2430 IF BC$="N" THEN 50000
2500 CS$="S2100S":GOSUB10000:FORJ=1TO2000:NEXT
2505 CS$="G":GOSUB10000
2510 Q8=200:GOSUB13000
2570 GOTO 2000
2800 PRINT"□":POKE 59468,14:PRINT:PRINT:PRINT
2810 PRINT"   YES, ITS TRUE !":PRINT:PRINT:PRINT
2811 CS$="S2100S":GOSUB10000:FORJ=1TO2000:NEXT
2812 CS$="G":GOSUB10000
2814 Q8=200:GOSUB13000
2820 PRINT"IN THE BEGINNING MOST OF THE EARTH'S"
2830 PRINT"WATER WAS STORED IN CLOUDS, FORMING ":PRINT
2840 PRINT"A DENSE WHITE ENVELOPE AROIUND THE PLANET":FORI=0TO3000:NEXT:PRINT
2850 PRINT"ZIPPING ALONG TO THE NEXT PROBLEM.":FORI=0TO2000:NEXT
3000 PRINT"□":POKE 59468,12:PRINT
3010 PRINT"(    )   (    )   (    )  (    )"
3020 PRINT"(    )  (    )  (    )  (    )"
3030 PRINT"  //// ////////// //// //////////"
3040 PRINT" // / /// /// / / / / / / / / /"
3050 PRINT"  /// /// / / /// /// // /// /"
3060 PRINT"  /// // /  // / //   / //  "
3070 PRINT" /\ / // / / ///  ///  \ / /\"
3080 PRINT"/  \/\/ / /  // / /       /  \ "
3090 PRINT"/\  \/  \/ / / /  /        /\  \  "
3100 PRINT"▒▒▒
```

Now with added words! *

ELECTRIC MOUTH



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- Four models, that plug directly into S100, Apple, Elf II and TRS-80 Level II computers.
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three	twenty	case	equal	it	off	set	e	v
four	thirty	cent	error	kilo	on	space	f	w
five	forty	400hertz tone	feet	left	out	speed	g	x
six	fifty	80hertz tone	flow	less	over	star	h	y
seven	sixty	20ms silence	fuel	lesser	parenthesis	start	i	z
eight	seventy	40ms silence	gallon	limit	percent	stop	j	
nine	eighty	80ms silence	go	low	please	than	k	
ten	ninety	160ms silence	gram	lower	plus	the	l	
eleven	hundred	320ms silence	great	mark	point	time	m	
twelve	thousand	centi	greater	meter	pound	try	n	
thirteen	million	check	have	mile	pulses	up	o	
fourteen	zero	comma	high	milli	rate	volt	p	
fifteen	again	control	higher	minus	re	weight	q	
sixteen	ampere	danger	hour	minute	ready	a	r	
seventeen	and	degree	in	near	right	b	s	

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all	"de"	forward	move	record	"th"
ask	deposit	from	next	reverse	thank
assistance	dial	gas	no	red	third
attention	door	get	normal	repair	this
blue	east	going	north	repeat	turn
brake	"ed"	green	not	replace	under
button	emergency	hale	notice	room	use
buy	enter	heat	open	safe	waiting
call	entry	hello	operator	second	warning
called	"er"	help	or	secure	was
caution	"eth"	hurts	pass	select	water
celsius	evacuate	hold	per	send	west
centigrade	exit	hot	power	service	wind
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```
4010 PRINT"        /\\                 ,-~)()\
4020 PRINT" SUN   /\\                 ( ()  ))
4030 PRINT"       /\\          ))))   (_)))))
4040 PRINT"      /\\\                    \_/ \_/
4050 PRINT"____/\\\\ \   ↑ ↑   ↑ ↑ ↑ ↑ ↑ ↑
4055 PRINT"\\\\\\ \\    ↑ ↑↑   ↑ ↑ ↑   ↑
4060 PRINT"\\\\\\\ \   ↑ ↑   ↑   ↑ ↑   ↑ /\
4070 PRINT"  /\        ↑ ↑ ↑ ↑   ↑ ↑↑/   \
4080 PRINT" /  \      ↑   ↑ ↑   ↑   ↑ /     \
4090 PRINT"/\/\/\↑↑↑ ↑↑↑ ↑↑↑ ↑↑↑↑/\/\/\/\
4100 PRINT"▒▒▒
```

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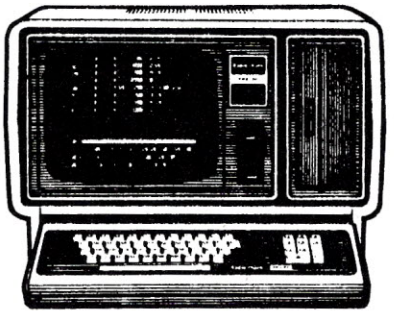

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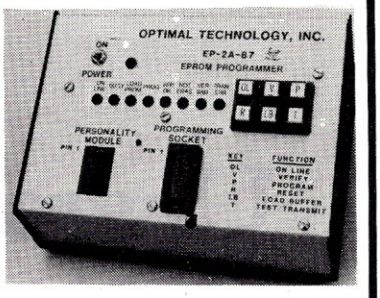

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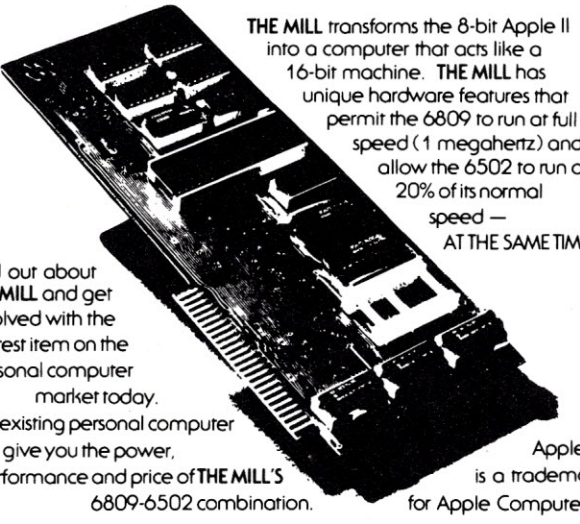

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The TRS-80 and the IP-225 get together with this simple interface circuit.

Upgrade Your IDS Printer

By Peter E. Noeth

The Integral Data Systems IP-225 is a good dot matrix printer with graphics capability. Unfortunately, as delivered, it will not directly interface to the TRS-80 Model I line-printer port. The following circuitry will allow this interface with a minimum of effort and cost.

Basic Problem

The difficulty lies in two areas. First, the strobe pulse in the TRS-80 is only 1.5 μs long and the IP-225 requires a minimum of 4 μs pulse. Second, the acknowledge pulse occurs 100 μs after the strobe is active. The printer status routine in the TRS-80 checks for this pulse to be active approximately 35–40 μs after it outputs a character (strobe active). If it does not see an active pulse the printer routine assumes the printer is ready and outputs the next character. (See Figs. 1 and 2.)

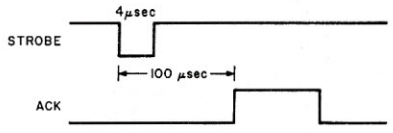

Fig. 1. IP-225 input timing.

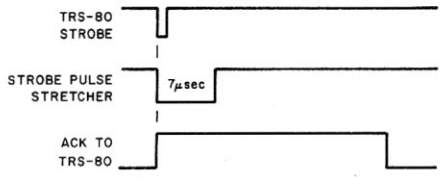

Fig. 2. Timing activity on interface circuit.

Solution

The circuit as shown in Fig. 3 will correct the above problems. In the circuit, the 74121 is used as a pulse stretcher to provide a 7 μs strobe pulse to the printer logic board. When the strobe from the TRS-80 goes low, the set input on the 7474 forces the Q output high. This will remain until cleared. When the ACK pulse from the IP-225 returns high (printer ready), it clocks the D input, which is tied low, and resets the Q output low. The result of this action provides an ACK active pulse to the TRS-80 as soon as the strobe is active, so no delay is evident to the printer status routine in the TRS-80 and no characters will be lost.

Interconnection

I built my circuit on a two-inch-square piece of perfboard using sockets for the two integrated circuits. I insulated the underside of the board with a piece of light cardboard and mounted it to the support between the transformer and the printer logic board on the bottom side of the IP-225, using RTV adhesive. This position allows you to break the leads coming from the printer logic board to the 25-pin interface connector on the back of the IP-225 to insert the new interface board. I also ran two wires from the ground and 5 V power bus on the printer logic board to provide the required power for the new interface. (See Fig. 4 for the connections.)

Although I designed this interface for the IP-225, it also could be used with any parallel I/O printer to be interfaced to the TRS-80 that does not meet the as-originally-designed timing requirements of the strobe and acknowledge pulses.■

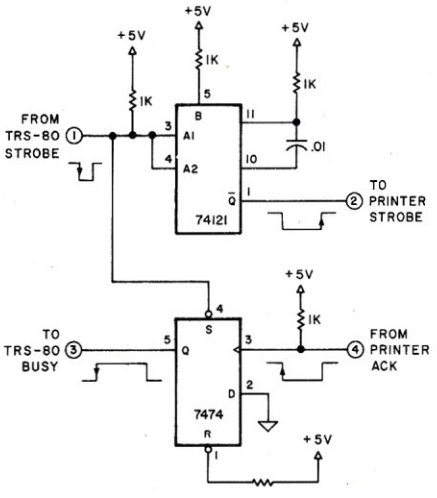

Fig. 3. IP-255 interface circuit.

Address correspondence to Peter E. Noeth, 6906 Lenwood Way, San Jose, CA 95120.

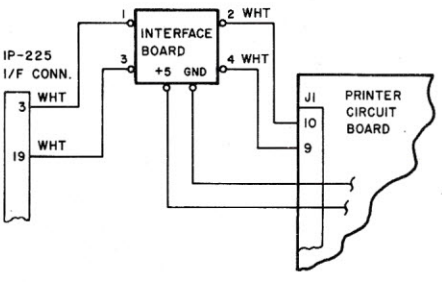

Fig. 4. Interface board interconnection.

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18	RRCONST	Rate of return on investment with constant inflows
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20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REGWITH	Equal withdrawals from investment to leave 0 over
24	SIMPDISK	Simple discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for oblig.
26	ANNUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
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30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
33	WARVAL	Value of a warrant
34	BONDVAL2	Value of a bond
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74	LABEL1	Shipping label maker
75	LABEL2	Name label maker
76	BUSBUD	DOME business bookkeeping system
77	TIMECLCK	Computes weeks total hours from timeclock info.
78	ACCTPAY	In memory accounts payable system-storage permitted
79	INVOICE	Generate invoice on screen and print on printer
80	INVENT2	In memory inventory control system
81	TELDIR	Computerized telephone directory
82	TIMUSAN	Time use analysis
83	ASSIGN	Use of assignment algorithm for optimal job assign.
84	ACCTREC	In memory accounts receivable system-storage ok
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86	PAYNET	Computes gross pay required for given net
87	SELLPR	Computes selling price for given after tax amount
88	ARBCOMP	Arbitrage computations
89	DEPRSF	Sinking fund depreciation
90	UPSZONE	Finds UPS zones from zip code
91	ENVELOPE	Types envelope including return address
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In this and the following article, Kilobaud Microcomputing *takes a close look at this highly touted printer from C. Itoh. The consensus is. . .*

Spotlight on the Starwriter

By Mark J. Borgerson

If you can wait a minute, we can save you $1000," claims C. Itoh about its Starwriter printer. But how much is a minute? After connecting my new Starwriter to my Apple II, I decided to find out.

I printed a page of text on the Starwriter, and then printed the same text on a Qume. The result: the Qume ($3415) took 123 seconds, while the Starwriter ($2230) took 173 seconds. The Starwriter, then, took about 42 percent longer than the Qume.

In a large office, where speed is important to efficiency, the extra printout time might not be worth the savings. But as a consultant and freelance writer, I can always find something to do while the printer cranks out my latest manuscript. I can also find a lot of things to do with $1185.

Two Steps

The engineers at C. Itoh took two steps to achieve the $1000 price reduction. First, they replaced the expensive and complicated servo drive mechanism that Qume, NEC and Diablo printers use to position the printhead with a high-resolution stepping motor. The motor's limited stepping speed is probably responsible, at least in part, for the lower print speed of the Starwriter. Second, they used an 8085 microprocessor as a system controller and minimized the complexity of the printer's electronics.

As far as I can tell, they cut no corners in the mechanical assembly of the printer. The case is cast-aluminum, well-covered inside with sound-deadening foam. The printer frame is a hefty aluminum casting, and the bearings, guide rails and cables controlling the printhead all seem comparable in quality to the more expensive daisywheel printers.

My printer came with a standard Centronics parallel interface. An RS-232 serial interface is also available as an option. The printer is plug-compatible with a number of interfaces for the Apple—I chose the Epson interface (generally sold with the Epson MX-80) because it costs about $90 less than the Apple Centronics interface. The Epson card is completely hardware- and software-compatible with the Apple interface.

The Starwriter has several internal switches which allow you to select operating modes for the printer. A toggle switch inside the front cover lets you select ten or 12 characters per inch. The standard printer is equipped with a ten-pitch Courier print wheel. (The printer uses the widely-available Diablo print wheels and ribbons.) A set of DIP switches inside the rear cover control functions such as default form length and auto line-feed.

```
@b      Bold-Face Print  can be used
         to accent words.
@-      Underlining  also makes words
         stand out.
@u, @d  These commands give super and subscripts.
@sl0,20,30.  This sets tab stops at columns
              10,20 and 30.
@t      This command moves the print head to
         the next tab stop.
```

Example 1.

Address correspondence to Mark J. Borgerson, 1624 NW Kings Blvd., Corvallis, OR 97330.

The Starwriter/Starwriter II daisywheel printer.

One of the most important option switches controls the printer mode. This switch has two positions: serial mode and line mode. In the line mode, the printer will not print any characters until the full line is received. The printer will then print bidirectionally and use logic-seeking to minimize printhead movement. Sequences of space characters are converted to a single, continuous head movement. This mode is about 17 percent faster than the serial mode (I used the serial mode in the print speed comparison), but the printer will respond to only a few special commands.

In the serial mode, the printer responds to all the Qume control sequences, but prints unidirectionally. This cuts the print speed, but lets you use the reverse line-feed, tabbing and direct carriage control features the same as you would with a Qume. Since a lot of word processing software uses these features, you will probably want to use this mode most of the time. If however, you plan to do a lot of long program listings, the line mode may appeal to you.

Example 1 shows some of the special features available in the Qume emulation mode. It's a portion of the demonstration text provided with a software package I wrote called Stardriver, which extends the capabilities of the Apple-Writer word processor to let you include special print mode commands in your text.

Only One Problem

In the first six weeks that I owned Starwriter, I printed a number of short articles and two drafts of a 150-page book. With one small exception, the printer performed flawlessly. The exception had to do with the paper advance motor: the stepper motor which drives the platen and tractor feed is a little less powerful than I would like. At one time it stalled under load and caused several lines to overprint. I discovered that this is only a problem with heavy paper. The paper guide puts the paper under tension by running it between a metal plate and several foam pressure pads. The combination of heavy paper, friction and the weight of the paper (which sits in a box on the floor) was too much for the motor. I removed the paper guide (which I didn't need anyway) and have had no problems since.

A second problem might arise if you intend to implement a graphics program that uses extensive forward and reverse paper movements. The Starwriter tractor feed grips the paper only after it passes the platen. The Qume tractor, on the other hand, grips the paper both before and after it goes around the platen. This means that the Qume actually pulls the paper back when doing reverse line feeds. The Starwriter tractor will only pull the paper forward. Reverse movements depend on the platen friction. Thus, a possible registration problem may arise if you try multiple reverse paper movements.

Conclusion

If you can tolerate the loss in printer throughput and want to save a thousand dollars or more, take a close look at the Starwriter from C. Itoh. It is a well-designed, ruggedly constructed printer with a number of nice features. Among the most important of these is the printer's ability to imitate the Qume printer in applications where the special control codes of the Qume are employed. The printer also uses Diablo print wheels and ribbons, which are available through computer stores and office supply outlets in most cities.■

Letter-Quality Printer For the Budget-Minded

By William L. Colsher

The C. Itoh Starwriter has been a reliable and easy-to-use printer for my Apple III system, and I recommend it to anyone who needs letter-quality output on a budget.

I bought an Apple III back in December of 1980, primarily for word processing. The dealer warned me that the software would not be available for some time, but I went ahead with the purchase so I could become familiar with the system as quickly as possible. I decided to forego a printer until Word Painter, Apple's word processor, came to market.

I soon discovered the power of VisiCalc III and Business Basic, and almost as quickly realized that I still needed a printer. What good is a VisiCalc back order report if you can't print it out?

Since I planned to use the Apple III for word processing, it seemed sensible to purchase a letter-quality printer. Apple distributes the Qume, but I felt that it was a little high-powered (and expensive) for my needs. A little research turned up the C. Itoh Starwriter. At a price about $1000 less than the other letter-quality printers on the market, it looked like the machine for me.

Naturally, something had to be sacrificed for that much money. My Starwriter prints at 25 characters per second, roughly half the speed of the more costly machines. But for my purposes, time is not critical.

The Starwriter is a massive unit. It weighs 19.5 kilos, almost 43 pounds. A look inside the housing reveals the reason: the mechanism is supported by a massive die-cast aluminum frame. This printer is solid.

Since the Apple III does not yet have a parallel printer interface card, connecting the Starwriter was not quite the plug-it-in-and-print operation it often is with Centronics-type machines. Further, since the Apple III does nearly everything with software, getting the built-in serial port

Transmission Speed

BPS	S1	S2
2400	open	open*
1200	closed	open
600	open	closed
300	closed	closed

Parity	S5	S6
even	open	open
odd	open	closed*
none	closed	open

Character Length	S3
7 Bits	closed*
8 bits	open

Stop Bits	S8
1	closed*
2	open

*Indicates factory setting.

Table 1. Printer settings. (From C. Itoh Electronics' Starwriter User's Manual, *pp. 4–5.)*

My Apple III and a C. Itoh Starwriter, being checked out at my dealer. Note the size of the printer relative to the 12-inch monitor and the Apple.

Address correspondence to William L. Colsher, 1711 Robin Lane, Lisle, IL 60532.

to talk with the outside world involves more than flipping a couple of switches to set the data rate.

The Apple III serial port is configured as data terminal equipment (DTE). This allows the Apple III to function with the correct software as a smart terminal. Since a printer is also a DTE device, you need a modem eliminator, which is simply a short piece of cable that connects the pin the Apple III is sending on to the pin the printer expects to receive data on. Without the modem eliminator, the Apple III would send data on the same pin that the printer is trying to send data on—something like two deaf and blind people talking to each other.

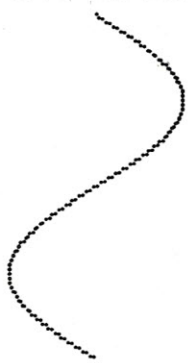
Apple supplies a modem eliminator with each Apple III, so the wiring is simple. Plug the eliminator into the Apple and then plug the printer cable into the other end of the modem eliminator.

As I mentioned earlier, the Apple III uses software to control operation. There are no DIP switches to set the data rate and format. Instead, there is a device driver. All of the Apple III's input-output operations are handled by these routines. This allows enormous freedom in writing applications programs, since all devices look the same to the program (e.g., by calling a disk driver ".PRINTER" your 10M Winchester can be used to spool printed output for later physical printing).

In order to alter a device driver, use a program called the System Configuration Program (SCP) that is supplied on the Apple III utilities disk.

I personally dislike poking around

```
     In addition to the usual capabilities one expects from any printer, the
Starwriter has a number of interesting features that add considerably to it's
versatility.  For example, by transmitting the sequence: ESC D, the
Starwriter will f                                                  d back down!
                e                                                e
                  e                                              e
                  d up half a space. The ESC U sequence will f
It is also possible to set the vertical spacing in 1/48 inch increments and
the carrier pitch in 1/120 inch increments.  By using these commands it is
possible to use this machine as a graphics printer...
```



```
PRINT#1;CHR$(27);'E02';CHR$(27);'L01'
pi=3.14159
FOR theta=0 TO 2*pi STEP (1/24)
  tabfactor=INT(SIN(theta)*48)+100
  PRINT#1; TAB(tabfactor);'.'
  NEXT theta
```

Sample 1. Printout showing Starwriter's sub- and superscript abilities.

Value 1—Data Rate

Value	Speed
03	110 baud (Teletype speed)
04	134.5 baud (Selectric speed)
06	300 baud (normal telecommunications speed)
07	600 baud
08	1200 baud (normal printer speed)
09	1800 baud
0A	2400 baud (C. Itoh printer speed)
0C	4800 baud
0E	9600 baud

Value 2—Data Format

Value	Format
22	7 bits, odd parity
26	7 bits, even parity
2A	7 bits, mark parity
2E	7 bits, space parity
00	8 bits, no parity
42	6 bits, odd parity
46	6 bits, even parity
4A	6 bits, mark parity
4E	6 bits, space parity

Table 2. Apple III .PRINTER control values. (Tables from Apple III Standard Device Drivers.*)*

1. Boot the Apple III using the System Utilities disk.
2. Select option 3—System Configuration Program (SCP).
3. Select SCP function 1—add a driver file.
4. Place the disk with the driver file you want to alter in disk drive 2. If you have only one disk drive, remove the System Utilities disk and use that disk drive. (Be sure to substitute ".D1" for ".D2" when it appears below.)
5. In response to the prompt "enter driver file name:" type: .d1/sos.driver and press return.
6. Press return when the file has loaded to go back to the SCP menu.
7. Select SCP function 3—edit driver parameters.
8. Enter the number of the ".PRINTER" driver when the program asks for it.
9. Select item 5—configuration block data—when you are asked for a number.
10. Use the cursor keys to move the box to the value you want to alter.
11. Press return when you have made all the changes you want.
12. Press return to leave the edit driver parameters screen.
13. Press return to leave the select driver to be edited screen.
14. Select SCP function 5—generate new system.
15. Enter a new driver file name; for example, .d2/new.driver.
16. When the new driver file has been written, press return to go back to the SCP menu.
17. Select option 7—Quit.
18. Select option 4—Quit.
19. Reboot the Apple III with the disk containing your new driver file. In Business Basic:
    UNLOCK SOS.DRIVER (return)
    RENAME SOS.DRIVER,OLD.DRIVER (return)
    RENAME NEW.DRIVER,SOS.DRIVER (return)
    When you boot using that disk you will be using your new drivers.

Table 3. Changing a device driver.

in hardware with lots of moving parts. For me, the simplest course was to alter the device driver to agree with what my new printer expects. Table 3 shows the procedure for changing a driver. As you can see from Table 2, Apple has allowed for just about any printer that uses RS-232C interfacing. Just a few keystrokes and you're ready to print.

After setting up the new device and connecting the printer, I was ready to check it all out. So after booting Business Basic I opened the ".PRINTER" file and sent out a print command. Nothing happened. I checked the cables. (There are no screws on the eliminator cable to hold it, the Apple III and the printer cable together: one of Apple's few oversights with this machine!)

After considerable head-scratching, I discovered the rather unusual "paper-out" mechanism on the Starwriter. It's incorporated into the paper feed rack rather than into the platen support, as on my Epson MX-80. I put the paper in correctly and printed out "test. . . test. . . test" a few times, and then began to explore some of the other capabilities of my new machine.

I had expected a very basic printer for my money, but I soon found that the Starwriter has some interesting capabilities. Table 4 lists the various control codes available on the Starwriter. The most interesting are the vertical and horizontal spacing controls.

Sample 1 shows some of the things that I've learned to do so far. I expect to make good use of the super- and subscripting feature, particularly if Apple brings out a graphing package for use with this type printer. You can do some pretty fair plotting on the Starwriter. Apple has a plotting package for the old Apple II that uses the Qume printer in much the same manner. If control codes are universal, as implied in the Starwriter manual, it should be easy to adapt the existing code to the Apple III. ■

Starwriter at a Glance

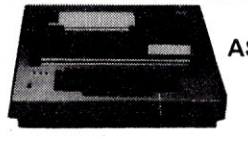
Printing Speed	25 characters per second
Horizontal Spacing	1/120 inch min.
Vertical Spacing	1/48 inch min.
Carriage return time	1 second
Line feed time	40 msec (1/6 inch)
Paper width	381 mm maximum
Number of copies	3
Font	Diablo plastic wheel compatible
Power	90-127 VAC, 50/60 Hz, 70 W
Dimensions	625 mm wide, 380 mm deep, 258 mm high
Weight	19.5 kg

Address: C. Itoh Electronics, 5301 Beethoven St., Los Angeles, CA 90066.

Code	Function
FF	Form feed
ESC D	Half line feed down
ESC U	Half line feed up
ESC SP	Printing
ESC 1	Set horizontal tab 1 to present position
ESC 2	Clear all H tabs
ESC 9	Left margin set
ESC 0	Right margin set
ESC L (d1) (d2)	vertical spacing set in 1/48-inch increments
ESC E (d1) (d2)	horizontal space set in 1/120-inch increments
ESC ((list)	Tab set list where list is of the form d1d2. . . to a maximum of 16 locations. Tabs are absolute
ESC SUB I	Reset

Table 4. Printer control codes. (From Starwriter User's Manual.*)*

SURPLUS ELECTRONICS



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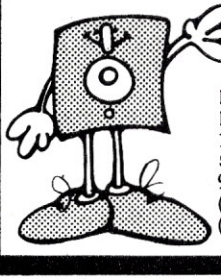

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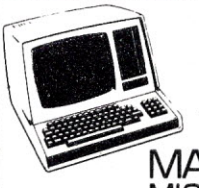

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- Uses + 5V & ± 12V Power Supplies
- Does not have graphic capabilities.

Documentation includes program listing and composite video circuit.

Bare Board only (with doc)	**$39.95**
2716 Char. Gen. A7	**$19.95**
2716 Program A12	**$19.95**

A-D CONVERTER

JBEs 16 channel A-D Converter plugs into your Apple II computer. It uses an ADC0817 which incorporates a 16 channel multiplexer and an 8 bit A-D Converter. The 16 inputs are high impedance and the voltage range is 0 to 5.12 volts. Conversion time is <100 μsec. The resolution is 8 bits or 256 steps, linearity is ± 1/2 step. Two 16 pin DIP sockets are used for input, GND & reference voltage connections. There are 3 single bit TTL inputs. Doc. Includes sample program.

81-132A Assm.	**$89.95**
81-132K Kit	**$69.95**
81-132B Bare Board	**$29.95**

EPROM PROGRAMMER

JBE's EPROM Programmer is designed to program 5V 2516's, 2532's & 2716's. It interfaces to the JBE Parallel I/O card using four ribbon cables. An LED indicates when the EPROM is being programmed. A textool zero insertion force socket is used for the EPROM. Comes with complete documentation for writing and reading EPROM's in the Apple II or Apple II Plus. Cables available separately.

80-244A Assm.	**$49.95**
80-244K Kit	**$39.95**
80-244B Bare Board	**$24.95**

PARTS

6502 MPU	**$9.95**
6522 VIA	**$9.95**
Z-80 MPU	**$9.95**
Z-80 PIO	**$9.95**
TWO 2114 RAM	**$9.95**
2716	**$14.95**
50 pin conn.	**$5.95**
Dip Jumper 2 ft.	**$4.95**

6522 APPLE II INTERFACE

The JBE 6522 Parallel Interface for the Apple II Computer, plugs directly into any slot 1 through 7 in the Apple. This card has 2 6522 VIA's that provide:

- Four 8 bit bi-directional I/O ports
- Four 16 bit programmable timer/counters
- Serial shift registers
- Handshaking

A 74LS05 is for timing. Four 16 pin sockets provide easy connections to other peripheral devices. (Dip jumpers with ribbon cables are also available from JBE) The 6522 Parallel I/O card interfaces to the JBE EPROM programmer. Understanding of machine language required to use this board. Inputs and outputs are TTL compatible.

79-295A	**$69.95** Assembled
79-295K	**$59.95** Kit
79-295B	**$19.95** Bareboard

SPEECH SYNTHESIZERS

JBEs Speech Synthesizers use the Votrax SC-01 Phoneme Synthesizer chip. The SC-01 phonetically synthesizes continuous speech of unlimited vocabulary. The SC-01 contains 64 different phonemes and 4 levels of inflection accessed by an 8 bit code. It requires 10 Bytes per second for continuous speech. Both boards have an audio amp for direct connection to an 8 ohm speaker.

Documentation includes basic user programs, a phoneme chart and listing of coded words to help you get started. Documentation for the Apple II® Speech Synthesizer includes a disk with many user programs.

81-088 Apple II Speech Synthesizer	**$139.95**
81-120 Parallel Input Speech Synthesizer	**$149.95**

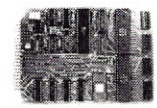
Prices include the SC-01 Chip
SC-01 sold separately for **$ 75.95**

EPROM EXPANSION CARD

JBE EPROM Expander for the Apple II holds six 5V 2716s for a total of 12K bytes of EPROM. This board takes the place of the on board ROM in the Apple. It is software switchable by the same technique used by the Apple II firmware card. Solder jumpers are for reset to the Apple ROM or EPROM Expansion Card. Use JBE EPROM Programmer and Parallel I/O to program your EPROMs. EPROMs sold separately.

81-085A Assm.	**$59.95**
81-085K Kit	**$49.95**
81-085B Bare Board	**$39.95**

81-260 "SLIM"



Single board large scale Integration Microcomputer. This 4.5 x 6.5 board uses the 6502 Microprocessor, two 6522 VIA's, four 2114 RAM's, 2516, 2716 or 2532 EPROM. The fully buffered 22/44 pin bus is similar to the KIM® , SYM® , and AIM® expansion connector. The four 8 bit I/O ports connect through 16 pin dip sockets. This board was designed for control and is ideal for Personal and OEM use.

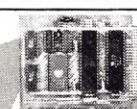
- 6502 MPU
- Two 6522 VIA's
- Four 2114 RAM's (2K bytes)
- One EPROM 2516 or 2532
- Crystal clock 1 Mhz
- Requires 5V 1AMP Power
- 4.5 x 6.5 card
- Power on reset
- Fully buffered-expandable
- Solder mask-both sides

Use your Apple II Computer, JBE 6522 Parallel Interface card and EPROM Programmer as a development system for SLIM.

Prices:

81-260A	**$199.95** Assembled
81-260K	**$149.95** Kit
81-260B	**$ 39.95** Bare Board

6502 MICROCOMPUTER

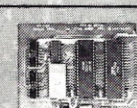


6502 MPU, 6522 VIA, 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 400 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 1 Mhz clock.

Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

80-153 Assm.	**$110.95**
80-153 Kit	**$ 89.95**
80-153 Bare Board	**$ 19.95**

Z-80 MICROCOMUTER

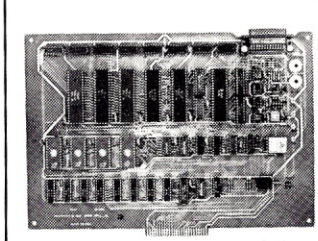


Z-80 MPU, Z-80 PIO, 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 300 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 2Mhz clock.

Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

80-280 Assm.	**$129.95**
80-280 Kit	**$119.95**
80-280 Bare Board	**$ 19.95**

JBE I MICROCOMPUTER



JBE's 7.75 x 11.75 6502 base Microcomputer has the capacity for 16K of EPROM, 4K of RAM, 8 Parallel Ports and 1 Serial Port. Monitor and Tiny Basic are also available. The fully populated version includes:

- 1 6502 CPU
- 4 6522 VIA (8 Parallel I/O Ports)
- 1 AY5-1013 (Serial I/O Ports)
- 8 2114 RAM (4K)
- 2 2716 EPROM (Monitor & Tiny Basic)

The partially populated version includes:

- 1 6502 CPU
- 1 6522 VIA (2 Parallel I/O Ports)
- 1 AY5-1013 (Serial I/O Port)
- 2 2114 RAM (1K)
- 1 2716 EPROM (with Monitor)

Both versions include sockets for 2716s or 2532s, 8 16 pin sockets for I/O interfacing and a DB25 connector for RS232.

All address and data lines are brought off the board to the 50 pin edge connector. (similar to the Apple II bus)

This board also features power on reset and cassette interface.

81-030 C Fully Populated	**$349.95**
81-030M Partially Populated	**$249.95**
81-030B Bare Board	**$ 89.95**
2716 EPROM (with Monitor)	**$ 19.95**
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Expand Your Horizon

By Patrick Corry

It should be easy! Many intriguing projects begin with this thought. So it was when we decided to transfer a BASIC program from a time-shared minicomputer to our North Star Horizon microcomputer.

Of course, I knew that there are several dialects of BASIC, many of which are customized for a specific environment. But in some cases editing problems are minimal. For example, Hewlett-Packard BASIC and North Star BASIC are similar.

We planned to move the program without retyping. The time-shared system listed a program. Then we promptly shifted the connector from the acoustic coupler to the console port of the Horizon. After waiting an appropriate time we connected the terminal to the Horizon and tried to list the acquired text. Surprisingly, nothing had been received! Since then the mystery has been solved.

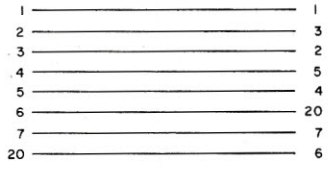

Fig. 1. Crossover cable. Use 25 pin connectors.

We have written a program which enables the operator of the Horizon's terminal to conveniently:

- Exchange data with information networks and computerized bulletin boards
- Store data received in programmable random-access memory (RAM) or on disk for subsequent display, transmission or printout
- Download programs transmitted by remote time-share computers or other personal computers.
- Edit text by means of a BASIC program
- Cause BASIC to accept a sequence of ASCII characters contained in RAM as an input program.

There are three categories of problems associated with our method of data transfer.

To specify operation of both serial ports with one stop bit and a seven-bit code we modified DOS 5.2 (origin zero) as follows:

1. Boot DOS and type LF DOS 4000
2. Type GO M0E00 and use the DS command to change the bytes at 4892 (hexadecimal) and 4896 from EC to 7A
3. Type OS to return to DOS
4. Type SF DOS 4000
5. Reboot DOS

Table 1. Stop bit modification of North Star DOS 5.2.

The Connection Problem

According to the widely-used RS-232C convention, both computers and modems transmit data on line 3 of the connecting cable. They both receive data on line 2. Therefore, the connecting cable between the Horizon's second serial port and the acoustic coupler must cross-connect lines 2 and 3.

A direct solution is to buy or make a crossover cable (see Fig. 1). Another solution is to wire a switch to the motherboard of the Horizon which will let you change the status of the second serial port between modem and terminal modes. If you select the latter option, consult the hardware manual (HRZ-D, p.72) supplied with your Horizon.

The Timing Problem

Most systems with which we communicate exchange data at the rate of 300 bits per second (bps)—about 30 characters per second. Therefore after accepting a character from the modem the Horizon must be ready to receive the next character after a delay of no more than 1/30 of a second. Within this allotted time the received character must be processed and transmitted to the terminal for dis-

Address correspondence to Patrick Corry, 11 Beechwood Drive, Shirley, NY 11967.

play. Since our terminal also operates at 300 bps, it requires 1/30 of a second after receiving one character before it can accept the next.

The consequences of these timing constraints are illustrated in Fig. 2. As shown, the terminal must accept characters at least as fast as the remote source sends them. Otherwise, characters will not only be absent from the display but also will not be stored in the Horizon! Therefore, it is critical that the Horizon send characters to the terminal using the minimum number of stop bits.

The DOS supplied with the Horizon can be easily personalized to send one stop bit. All that is needed is to change two bytes of DOS 5.2 from EC (hexadecimal) to 7A. See Table 1 for specific instructions. If your terminal operates at a higher data rate than that of the remote (sending) computer, this modification should not be necessary. In any case, the Horizon must not use too much time before sending received characters to the terminal. The fastest procedure is to have the Horizon simply store the character in a RAM buffer and immediately transmit the character to the terminal. The NSCOM program, which is written in BASIC, uses machine-language subroutines to achieve the speed necessary for this procedure (see Listing 1).

The Software Problem

For communication with an external source we connect the data cables as shown in Fig. 3. In addition, special software is needed to allow the Horizon to simultaneously accept input from two sources. Furthermore, we want the capability of storing part or all of the communicated data. If the data is the text of a program it should be accessible to the North Star interpreter. These operations are selected by input to the BASIC program, NSCOM. The relevant command menu is given in Table 2.

Our solution is to partition the available RAM space by use of the MEMSET command so that the directing program, NSCOM, and the stored communications may coexist. (See Table 3.) The upper limit of space available to NSCOM is chosen to yield the maximum room in memory for the ramfile. This limit was found by experimentation and is defined by the variable M in the second line of NSCOM. The start of the ramfile is labeled S and satisfies S = M + 50.

Communication: This command allows full duplex communication between the console terminal and a computer or modem connected to the Horizon's second serial port.

Display: The contents of the ramfile is listed on the console terminal. Control C may be used to stop the listing.

Echo: The contents of the ramfile is transmitted out the second serial port by means of a subroutine called ECHO. This subroutine will only transmit a character after the preceding character has been echoed back by the remote system. A control "C" entered at the console will abort the transfer and invoke the communication mode.

Feed: This command causes the set of ASCII characters stored in the ramfile to be sent to the BASIC interpreter which is cold-started.

Garbage removal: This command calls a machine-language subroutine which writes nulls over any sequence of characters in the ramfile that are not bounded by a number and a carriage return.

Kill: The end of file marker is filled in the first cell of the ramfile. Therefore new data will be written over previously received data.

Load: A request is sent to the DOS to load into RAM the diskfile whose name is input. The usual DOS naming conventions and responses are observed.

Message: This command will send the message specified by the data in the third line of NSCOM to the second serial port. In the DATA line, control characters are indicated by a leading "+" sign. For example, a carriage return is specified by a "+M". See Appendix 4 of the North Star Software Manual for the control codes. At the completion of the message the communication mode is entered.

Print: The contents of the ramfile is sent out the second serial port. Use a standard data cable to connect this port to a printer. Alternatively the ramfile could be sent out a parallel port if one is implemented.

Save: A request is sent to DOS to save the ramfile on diskette. The usual DOS naming conventions and responses are observed.

Unkill: The command negates the effect of the kill command by replacing the character at the first cell of the ramfile.

Where?: The end of the ramfile and the highest available RAM address are found. The user should not attempt to store data beyond this address.

NOTE: A disk directory may be obtained by typing a 1 or a 2 depending on the drive of interest.

Table 2. NSCOM commands—type only the first letter.

Listing 1.

```
1 REM -> NSCOM BY PATRICK CORRY - 9/2/81
5 IF EXAM(95)<>237 THEN CHAIN "SETUP" \ REM->VERIFY INITIALIZATION OF USR'S
10 DATA " +M SIGN-ØN MESSAGE +M"
15 W1=237\C1=100\F1=44\G1=0\D1=50\Z1=211\REM->USR STARTS
20 M=21000\ REM->ADDRESS OF  HIGHEST BYTE AVAILABLE TO BASIC
30 S=M+50 \REM->S IS THE START OF THE RAMFILE (S= 21050=523AHEX)
35 REM->RESERVE 50 BYTES FOR DOS COMMANDS
40 DIM M$(50)
50 IF EXAM(3593)+256*EXAM(3594)=M THEN 80
60 !"PLEASE MEMSET TO ",M," AND RUN AGAIN"\END\ REM->ALLOW ROOM FOR RAMFILE
80 IF Q9=0 THEN 920\ REM->CHECK FOR AVAILABLE RAM
90 IF FREE(0) > 75 THEN 100\!\!\!"***RUN AGAIN***"\END
100 !FREE(0)
110 !" COMMAND",
120 INPUT C$
130 IF C$="S" THEN 410
140 IF C$="K" THEN 1070
150 IF C$="U" THEN 1090
170 IF C$="F" THEN 580
180 IF C$="C" THEN 300
190 IF C$="P" THEN 680
200 IF C$="L" THEN 410
220 IF C$="M" THEN 800
230 IF C$="D" THEN 680
240 IF C$="W" THEN 920
250 IF C$="G" THEN 1060
255 IF C$="1" THEN 1100\IF C$="2" THEN 1100
257 IF C$="E" THEN 1200
260 !"(C)OMMUNICATE OR (D)ISPLAY OR (F)EED "
265 !"OR (G)ARBAGE REMOVAL OR (K)ILL OR (L)OAD OR"
270 !"(M)ESSAGE OR (S)AVE OR (P)RINT OR (W)HERE OR (1) OR (2)"
290 GOTO 90
299 REM-> COMMUNICATIONS MODE
300 E=CALL(W1,S)\ REM->FIND CURRENT END OF RAMFILE
310 !"CURRENT END OF RAMFILE ",E
320 !"COMMUNICATION MODE"\ E1=E
330 E=CALL(C1,E)
350 IF E=E1 THEN 370
360 IF E<>C1  THEN 380
370 !"NO EXTERNAL DATA FILED IN RAM."
380!\ !"NEXT BYTE AT ",E
390 GOTO 90
400 REM-> CREATE DISK IMAGE OF RAMFILE OR LOAD RAMFILE FROM DISK
410 IF C$<>"L" THEN 440 \REM-> C$ IS "L" OR "S"
420 !"LOAD RAM FROM WHICH DISK", \GOTO 480
440 E=CALL(W1,S)
450 B= INT((E-S+1)/256)+1\ REM->CALCULATE # OF BLOCKS
460 !"SAVE RAMFILE ENDING AT ",E," IN WHICH DISK",
480 !"FILE",\INPUT F$\IF C$="L"THEN 510
490 CREATE F$,B,10
```

More

The end of the ramfile is the first address which holds the value 06. These definitions result in 50 bytes of free space which can be used to store commands issued to North Star DOS 5.2. By use of this command buffer we have dramatically reduced the time needed to save and load files. Programmers should note that this technique can be applied to give DOS a sequence of commands in a more general context.

How to Set Up NSCOM

To use the unmodified version of NSCOM given here you need a computer running North Star DOS 5.2 with origin 0000 (hexadecimal) and BASIC with origin 0E00. Also required is a minimum of 24K bytes of continuous RAM starting at zero and two serial ports addressed in the standard manner. The user subroutines called occupy memory locations 0 to 255.

To enter NSCOM and its satellite machine-language routines you must type and save two BASIC programs: NSCOM and SETUP (see Listings 1 and 2). When SETUP is run the machine-language routines are filled into RAM starting at address 0000, and a chain to NSCOM is executed. When you type NSCOM you may omit the REM statements since they are not destinations for branch statements.

The boundaries of NSCOM, the command buffer, and the ramfile may be changed by modifying lines 20 and 510 of NSCOM. You should redefine M in line 20 and the command string in line 510. These changes will allow you to increase the size of the ramfile if you shrink BASIC or use floating-point BASIC. The command string must contain the value of S expressed in hexadecimal notation. A useful modification for users having parallel printers is to change the device code in line 720. Users of single-density systems should modify line 450.

How to Use NSCOM

NSCOM has three modes of operation: command, communication and storage. After SETUP is completed the command mode is entered. As shown in Table 2, the C command will invoke the communication mode. In this mode two-way communication with an external source is possible. Two control characters have special meaning. Control Q will cause a return to the command mode and Control F will invoke the storage

Listing 1 continued.

```
510 M$=C$+"F "+F$+" 523A"+CHR$(13)\ REM->DOS COMMAND STRING
515  REM->M+1 IS THE START OF THE COMMAND BUFFER
520 FOR J=1 TO LEN(M$)\FILL M+J,ASC(M$(J,J))\NEXT J
530 FILL M+J,06\ REM->END OF COMMAND MARKER
540 FILL 65,40\FILL 66,01\REM->MODIFY USR TO JUMP TO DOS
550 Q=CALL(D1,M+1)\REM->SEND DOS COMMAND
560 FILL 65,0\FILL 66,14\ REM->REPLACE JUMP TO BASIC  COLD START
570 GOTO 90
580 REM-> FEEDER RESETS MEMSET TO Q9 AND COLD STARTS BASIC
600 FOR J= 95 TO 98\FILL J,0\NEXT J\ REM->MODIFY USR TO COLD START BASIC
605 FILL 3598,165\ REM->SET MAXIMUM LINE LENGTH
610 E=CALL(W1,S)
620 !"FEEDING BASIC  RAM FROM ",S+1," TO ",E
625 !"REMOVE GARBAGE FIRST",\INPUT F$
630 IF F$="NO" THEN 650
640 Q=CALL(G1,S)\REM-> REMOVE GARBAGE
650 Q=CALL(F1,S+1)\ REM->FEEDS BASIC RAMFILE -NO RETURN
670 REM->DISPLAY AND PRINT COMMANDS-
680 E=CALL(W1,S)
690 ERRSET 90,Q,Q\REM->TO CONTINUE PROGRAM ON CONTROLC
700 FOR J= S+1  TO E
710 IF C$ <>"P"THEN 730
720 !#1,CHR$(EXAM(J)),\REM->MOD. DEVICE CODE FOR PAR. PRINTERS
730 !CHR$(EXAM(J)),
740 NEXT J
750 ERRSET\ GOTO 90
800 REM->MESSAGE DATA AT 3RD LINE
810 READ M$\ !"MESSAGE:"
820 FOR J=1 TO LEN(M$)
830 IF M$(J,J)<>"+" THEN 850
840 J=J+1\X=ASC(M$(J,J))-64\GOTO 860
850 X=ASC(M$(J,J))
860 !#1,CHR$(X),\! CHR$(X),
870 IF X<>13 THEN 890
880 FOR K=1 TO 3000\NEXTK\! \ REM->TIME LOOP FOR REMOTE COMPUTER
890 NEXT J
900 GOTO 300\ REM-> ENTER COMMUNICATION MODE
910 REM-> FINDS THE END OF THE RAMFILE-
920 E=CALL(W1,S)
930 !"THE END OF THE RAMFILE IS ",E
940 REM->FIND THE HIGHEST ADDRESS OF THE CONTIGUOUS RAM
950 IF Q9<>0 THEN 1020
960 J=41\ Z9=EXAM(S+1)
970 J=J+1\ Q=J*512-1\IF Q < S THEN 970
980  Z=EXAM(Q)\ FILL Q,6
990 IF EXAM(Q)<>6 THEN 1010
1000 FILL Q,Z\ GOTO 970
1010 Q9=Q-512
1015 Q8=INT(Q9/256)\FILL 46,Q8\FILL 45,Q9-256*Q8\REM->PREPARE MEMSET FOR FEEDER
1020 !"SPACE REMAINING: ",Q9-E
1030 FILL Q9,6\ REM->PLACE ENDMARK FOR SAFETY
1040 !"HIGHEST AVAILABLE RAM ADDRESS: ",Q9
1050 GOTO90
1060 Q=CALL(G1,S)\ GOTO 90\REM-> USR TO NULLOUT GARBAGE CHARACTERS
1070 !"RESTARTING RAMFILE"
1080 Z9=EXAM(S+1)\FILLS+1,6\GOTO 90\ REM->KILL-NEW DATA OVERWRITES RAMFILE
1090 FILL S+1,Z9\ GOTO 90\ REM->UNKILL- CONTINUES RAMFILE
1100 M$= "LI"+C$+CHR$(13)+CHR$(13)+CHR$(13)\REM->CREATE DOS COMMAND
1110 GOTO 520
1199 REM -> INTIALIZE FOR ECHO ROUTINE-
1200 FILL 65,21\ FILL 66,0
1205 Q=CALL(D1,S+1)
1207 FILL 65,0\FILL 66,14\ REM->REPLACE JUMP TO BASIC  COLD START
1210 !\GOTO 300
```

```
5 REM-> SETUP FOR NSCOM - PATRICK CORRY 9/2/81
10 FOR J=0 TO 244
20 READ X
30 FILL J,X
40 NEXT J
50 CHAIN "NSCOM"
100 DATA 235,006,000,035,126,254,006,200,203,064,032,022,254,013
110 DATA 040,243,254,010,040,239,254,058,242,040,000,254,048,250
120 DATA 040,000,006,255,024,225,254,013,032,221,024,217,054,000
130 DATA 024,215,033,255,191,034,009,014,237,083,250,000,033,067
140 DATA 000,034,017,001,237,115,252,000,195,000,014,034,254,000
150 DATA 042,250,000,126,254,006,040,008,035,034,250,000,042,254
160 DATA 000,201,033,080,010,034,017,001,042,254,000,237,123,252
170 DATA 000,201,235,205,062,010,032,014,219,002,230,127,254,017
180 DATA 200,254,006,040,035,205,132,000,205,070,010,032,232,219
190 DATA 004,205,142,000,024,225,245,205,120,010,032,251,241,211
200 DATA 004,201,245,205,112,010,032,251,241,211,002,201,062,060
210 DATA 205,142,000,062,013,205,132,000,219,003,230,002,040,017
220 DATA 219,002,230,127,254,018,032,009,054,006,062,062,205,142
230 DATA 000,024,172,219,005,230,002,040,227,219,004,230,127,119
240 DATA 190,032,006,035,205,142,000,024,213,043,054,006,195,004
250 DATA 014,205,067,000,205,132,000,205,070,010,040,008,205,241
260 DATA 010,202,086,000,024,243,219,004,205,142,000,024,230,235
270 DATA 035,126,254,006,032,250,201
```

Listing 2.

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PRINTER PORT	YES	YES	YES
REAL TIME CLOCK	YES	YES	YES
24 X 80 CHARACTERS	YES	NO	NO
VIDEO MONITOR	YES	YES	YES
UPPER AND LOWER CASE	YES	OPTIONAL	YES
REVERSE VIDEO	YES	NO	NO
KEYBOARD	63 KEY	53 KEY	53 KEY
NUMERIC KEY PAD	YES	NO	YES
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HI-RESOLUTION B/W GRAPHICS, 480 X 192	YES	NO	NO
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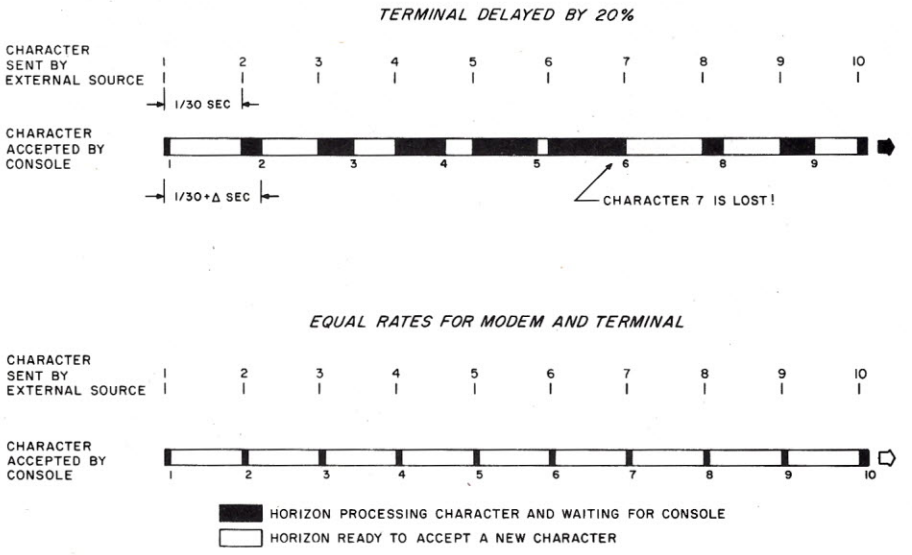

Fig. 2. Delay exaggerated for illustration.

```
10 REM->CHANGES ALL SINGLE QUOTAION MARKS, CHR$(39)
20 REM-> TO DOUBLE QUOTATION MARKS, CHR$(34)
30 PRINT " RAMFILE START", \INPUT S
40 S=S+1
50 IF EXAM(S)=6 THEN END
60 IF EXAM(S)=39 THEN FILL S,34
70 GOTO 40
```

Listing 3.

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mode. In the storage mode all characters received from the external source are stored in the ramfile. Now the only special character recognized is control-R, which causes a return to the communication mode. Although the user is responsible for not entering too large a ramfile, a warning is given when data is lost. This overflow condition is indicated by an uninitiated jump from storage to command mode (see Fig. 4).

In a work session with NSCOM you might take these steps:

1. Load and run SETUP.
2. The K command is used to restart the ramfile.
3. The C command is used to enter the communication mode.
4. Log on to a remote system and a BASIC program is fetched.
5. The LIST command is typed and terminated with a control F instead of the usual carriage return. The console will display an open bracket and a carriage return will be transmitted.
6. After the listing is completed a Control R is typed to return to communication mode. You may log off the remote system at this time.
7. A Control Q is typed to return to command mode.
8. The Save command is used to store the ramfile on diskette (a precaution).
9. The Feed command is used to send the ramfile to the BASIC interpreter.
10. The program is edited and saved using the utilities of North Star BASIC.

In another session you could log on to an information network such as The Source or Compuserve and search for data. After the desired data is located, it could be simultaneously listed on the terminal and stored in the Horizon's RAM. Later it could be saved on disk and printed.

The Feed commmand allows the BASIC interpreter to process a sequence of ASCII characters stored in RAM in the same way that a stream of characters coming from a terminal is handled. Therefore you can manipulate a program text while it is stored in RAM using BASIC programs. You can use this feature to do specialized editing. For example, all single quotation marks can be converted to double (see Listing 3). You can also create a series of DATA lines from the contents of memory. The data lines in the setup program were obtained by use of the program in Listing 4.

How NSCOM Works

The BASIC program NSCOM calculates and partitions the available RAM, prints prompts and status information and manipulates ramfiles. The files may be saved on disk, listed on the terminal, or transmitted out the second serial port. NSCOM calls five machine-language subroutines: GARBAGE NULLING (Listing 5), FEEDER, COMMUNICATION MODE, and ECHO (Listing 6) and EOT? (Listing 7). GARBAGE NULLING will write null characters over any character in the ramfile which is not surrounded by a number and a carriage return.

FEEDER is used to send commands to DOS, programs to BASIC, or characters to the ECHO subroutine. Accordingly NSCOM must modify the FEEDER subroutine. The initialization process for FEEDER changes the character-in call used by DOS 5.2. Characters are now obtained from RAM instead of the console port. Depending on which entry point to FEEDER is used the characters are sent either to DOS, to ECHO or to a cold-started BASIC. Communication mode alternately checks the two serial ports and sends characters received from one port to the other port. Upon receipt of a control-F, a jump is made to a routine which consecutively fills RAM with the characters entering the second serial port. It may be possible to upload the text contained in the ramfile to an external computer by use of the E command, which calls the ECHO subroutine. This routine transmits the ramfile out the second serial port with the constraint that the echo of a character must be received before the next character is sent. The effectiveness of this simple handshaking depends upon the software of the remote computer. The subroutine EOT? finds the address of the first cell of the ramfile that holds a value of 06 (the endmark). This address is

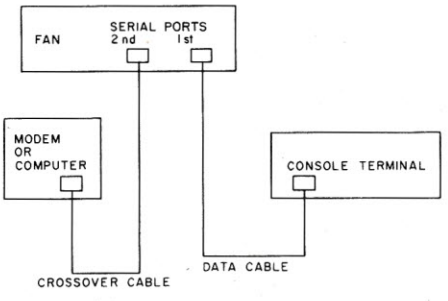

Fig. 3. Horizon back view.

Hexadecimal		Decimal
0000-00FF	Machine-language subroutines	0-255
0100-0DFF	DOS 5.2	256-3583
0E00-421D	BASIC (unshrunk)	3584-16925
421E-5208	NSCOM	176926-21000
5209-5239	Command Buffer	21001-21049
523A-RAMtop	Ramfile	21050-RAMtop

Table 3. Memory map—NSCOM standard configuration.

```
10 REM>= CREATES RAMFILE WITH ASCII DATA LINES FROM RAM CONTENTS
15 D$=" DATA "
20 S=21050\ A=S
30 !"START OF USR, END OF USR",\INPUT W,U
35 IF N= 0 THEN 80\ REM -> N COUNTS ITEMS PER DATA LINE
40 REM ->GET NEXT BYTE
50 B=EXAM(W)\GOSUB 110\ N=N+1
55 W=W+1\IF W=U+1 THEN 105
60 IF N=  20 THEN 80
70 A=A+1\ FILL A , ASC(",")\GOTO40
80 A=A+1\FILL A,13\A=A+1\FILLA,10
85 L=L+1\B=L\GOSUB 110
90 FOR K= 1 TO 6\FILL A+K,ASC(D$(K,K))\ NEXT K
100 A=A+6\N=1\ GOTO 40
105 FILL A+1,13\FILL A+2,6\ END
110 REM->A=NEXT AVAILABLE ADDRESS\ B=BYTE VALUE
130 A=A+1\FILL A,INT(B/100)+48\B=B-100*INT(B/100)
150 A=A+1\FILL A,INT(B/10)+48\B=B-10*INT(B/10)
160 A=A+1\FILL A,B+48\ RETURN
```

Listing 4.

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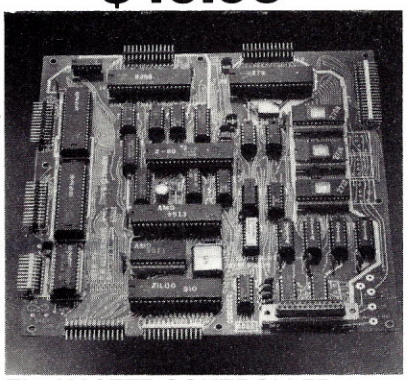

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placed in the HL register pair and passed back to NSCOM. Note that NSCOM uses the DE register pair when passing an address to the subroutines.

As mentioned, NSCOM also modifies the FEEDER routine when sending commands to DOS. Without this modification FEEDER would cold-start BASIC and allow it to use all the available RAM. When any BASIC program is running, the utilization of RAM is limited by the MEMSET command. This limitation will preserve the ramfile even if NSCOM is scratched and another BASIC program entered. Therefore you may stop NSCOM, load and run your own program, and then reload NSCOM without disturbing the ramfile. At the completion of a session of NSCOM use, BASIC should be cold-started in order to utilize all the available RAM.

Under development are procedures which allow the BASIC editing commands to be used on the text stored in the ramfile. A version of NSCOM which does not use the locations 0-255 is nearing completion. Improvements can be made in the software handshaking in the Message and Echo commands. The amount of space available for the ramfile can be increased by separating those commands which are only used once from NSCOM. These routines would be saved as a BASIC program which could be chained to from NSCOM.

Further streamlining can be achieved by removing REMs and spaces from NSCOM which were included to improve legibility. We are developing the capability of transmitting a break signal used by some remote systems. The ramfile could serve as an input buffer or be used for rapid sorting without disk access delays. Also to be explored are applications of NSCOM's facility for giving DOS and BASIC a sequence of commands without operator intervention.

An enhanced version of NSCOM on double-density disk will be commercially available. The hardware supplied with your Horizon allows for many communication options. I have enjoyed developing some relevant software.■

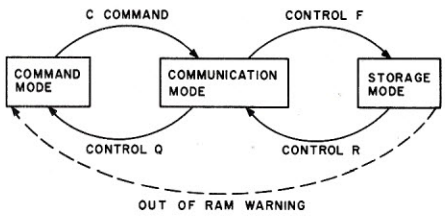

Fig. 4.

```
                                TITLE GARBAGE NULLING
                        ;REMOVES GARBAGE FROM RAMFILE
                        ;DE PASSED FROM NSCOM WITH START RAMFILE
0010                    .RADIX 16
                        .Z80
                        .PHASE 00H
0000    EB              EX DE,HL        ;USE HL AS POINTER
0001    06 00   RESET:  LD B,00H        ;FLAG RESET - NOT IN BASIC LINE
0003    23      COUNT:  INC HL          ;POINT TO NEXT BYTE
0004    7E              LD A,(HL)       ;GET CHAR
0005    FE 06           CP 06H          ;IS IT THE EOT MARKER?
0007    C8              RET Z           ;IF SO RETURN TO NSCOM
0008    CB 40           BIT 0,B
000A    20 16           JR NZ,EOL?      ;IF IN LINE LOOK FOR CR
000C    FE 0D           CP 0DH          ;CR OK
000E    28 F3           JR Z,COUNT
0010    FE 0A           CP 0AH          ;LF OK
0012    28 EF           JR Z,COUNT
0014    FE 3A           CP 3AH  ;>'9'?
0016    F2 0028         JP P,REPLACE
0019    FE 30           CP 30H  ;< '0' ?
001B    FA 0028         JP M,REPLACE
001E    06 FF           LD B,0FFH       ;SET FLAG - IN BASIC LINE
0020    18 E1           JR COUNT
0022    FE 0D   EOL?:   CP 0DH  ;CR INDICATES END OF LINE
0024    20 DD           JR NZ,COUNT
0026    18 D9           JR RESET        ;IT WAS THE EOL!
0028    36 00   REPLACE:LD(HL),00H      ;REPLACE GARBAGE WITH NULL
002A    18 D7           JR COUNT
                        .DEPHASE
```

Listing 5.

Listing 6.

```
                        TITLE NSCOM SUBROUTINES FOR DOS 5.2
                        ;AUG. 15,1981 - P. CORRY
                .PHASE 002CH
0010            .RADIX 16
                .Z80
00FA                    STPOINT EQU 0FAH        ;TO HOLD RAM POINTER
00FC                    STSP EQU 0FCH   ;TO HOLD STACK POINTER
00FE                    STHL EQU 0FEH   ;TO HOLD HL
0A50                    NORMAL EQU 0A50H   ;NORMAL IS DOS CHARIN ROUTINE START
BFFF                    MEMSET EQU 0BFFFH       ;48K?  NSCOM MODIFIES AS NEEDED
0E09                    HIMEM EQU 0E09H ;BASIC'S SCRATCHPAD FOR HIMEM
0111            VECT EQU 0111H   ;VECT HOLDS ADDR CURRENT INPUT ROUTINE START
```

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Listing 6 continued.

```
0E04                    WARM EQU 0E04   ;BASIC'S WARM START
0E00                    COLD EQU 0E00   ;BASIC'S COLD START
0A3E                    ISTO EQU 0A3EH  ;DOS 5.2 STATUS ROUTINES
0A46                    IST1 EQU 0A46H
0A70                    OSTO EQU 0A70H
0A78                    OST1 EQU 0A0A78H
                        ;FEEDER ROUTINE
002C  21 BFFF   INITD:  LD HL,MEMSET    ;HL=MEMSET FOR NEW BASIC
002F  22 0E09           LD(HIMEM),HL    ;SET MEMSIZE FOR NEW BASIC
0032  ED 53 00FA INIT:  LD(STPOINT),DE  ;DE PASSED FROM NSCOM - START RAMFILE
0036  21 0043           LD HL,FEEDER    ;HL = START OF FEEDER INPUT ROUTINE
0039  22 0111           LD(VECT),HL     ;CURRENT INPUT ROUTINE IS NOW FEEDER
003C  ED 73 00FC        LD(STSP),SP     ;SAVE BASIC'S STACK POINTER
0040  C3 0E00           JP COLD ;NSCOM WILL OVERWRITE THIS ADDR FOR DOS COMMANDS
0043  22 00FE FEEDER: LD(STHL),HL   ;SAVE BASIC'S HL
0046  2A 00FA           LD HL,(STPOINT)   ;HL POINTS TO NEXT CHAR
0049  7E                LD A,(HL)   ;GET CHAR
004A  FE 06             CP 06
004C  28 08             JR Z,RESTOR   ;IF EOT THEN RESTORE VECT TO DOS CHARIN
004E  23                INC HL   ;INCREMENT RAM POINTER
004F  22 00FA           LD(STPOINT),HL   ;STORE ADDRESS NEXT CHAR
0052  2A 00FE           LD HL,(STHL)   ;RETRIEVE BASIC'S OR DOS HL
0055  C9                RET   ;GO BACK TO BASIC OR DOS
0056  21 0A50 RESTOR: LD HL,NORMAL   ;HL = ADDRESS NORMAL IN ROUTINE
0059  22 0111           LD(VECT),HL   ;CURRENT IN ROUTINE IS NOW NORMAL
005C  2A 00FE           LD HL,(STHL)   ;RETRIEVE BASIC'S HL
005F  ED 7B 00FC        LD SP,(STSP)    ;RETRIEVE BASIC'S STACK POINTER
0063  C9                RET   ;RETURN IN CONTROL TO NSCOM OR  BASIC
                        PAGE 60
                        ;NSCOM - COMMUNICATION MODE
                        ;DE PASSED FROM NSCOM WITH START OF RAMFILE
0064  EB        TALK:   EX DE,HL        ;INIT HL AS POINTER
0065  CD 0A3E LOOKCON:CALL ISTO
0068  20 0E             JR NZ, LOOKEXT  ;IF NO CHAR LOOK AT SECOND PORT
006A  DB 02             IN A,(02)       ;GET CONSOLE CHAR.
006C  E6 7F             AND 7FH
006E  FE 11             CP  11H         ;^Q ->BACK TO NSCOM
0070  C8                RET Z   ;BACK TO COMMAND MODE OF NSCOM
0071  FE 06             CP 06H  ;^F -> ENTER STORAGE MODE
0073  28 23             JR Z, INITFIL   ;STORE COMMUNICATION IN  RAMFILE
0075  CD 0084           CALL SENDEXT    ;OTHERWISE SEND CHAR
0078  CD 0A46 LOOKEXT:CALL IST1
007B  20 E8             JR NZ, LOOKCON  ;IF NOT LOOK AT CONSOLE
007D  DB 04             IN A,(04)       ;GET EXT. CHAR.
007F  CD 008E           CALL SENDCON
0082  18 E1             JR LOOKCON      ;LOOK AT CONSOLE AGAIN
0084  F5        SENDEXT:PUSH AF
0085  CD 0A78 WAITEXT:CALL OST1
0088  20 FB             JR NZ, WAITEXT
008A  F1                POP AF  ;RETRIEVE CHAR.
008B  D3 04             OUT (04),A
008D  C9                RET
008E  F5        SENDCON:PUSH AF ;SAVE CHAR.
008F  CD 0A70 WAITCON:CALL OSTO
0092  20 FB             JR NZ, WAITCON
0094  F1                POP AF  ;RETRIEVE CHAR.
0095  D3 02             OUT (02),A      ;SEND CHAR.
0097  C9                RET
                        PAGE 60
0098  3E 3C  INITFIL:LD A,3CH       ;A='<'
009A  CD 008E           CALL SENDCON    ;SHOW "<" FOR STORAGE MODE
009D  3E 0D              LD A,0DH       ;A=CR
009F  CD 0084           CALL SENDEXT    ;SEND CR
00A2  DB 03     STOPFIL?:IN A,(03)      ;CHECK CONSOLE
00A4  E6 02             AND 02
00A6  28 11             JR Z,FILLRAM    ;IF NO CHAR INPUT CONTINUE STORAGE MODE
00A8  DB 02             IN A,(02)
00AA  E6 7F             AND 7FH
00AC  FE 12             CP 12H  ;IS CHAR A CONTROL R?
00AE  20 09             JR NZ,FILLRAM   ;IF NOT CONTINUE FILLING RAM
00B0  36 06             LD (HL),06      ;WRITE EOF MARKER
00B2  3E 3E             LD A,3E         ;A='>'
00B4  CD 008E           CALL SENDCON
00B7  18 AC             JR LOOKCON      ;CONTINUE TALK MODE
                        ;STORAGE MODE FOR NSCOM
                        ;THE FOLLOWING STORES COM IN RAM UNTIL ^R FROM CONSOLE
00B9  DB 05     FILLRAM: IN A,(05)      ;GET STATUS BYTE
00BB  E6 02             AND 02
00BD  28 E3             JR Z,STOPFIL?   ;IF NOTHING THERE LOOK AT CONSOLE
00BF  DB 04             IN A,(04)       ;GET CHAR FROM SECOND PORT.
00C1  E6 7F             AND 7FH
00C3  77                LD(HL),A        ;STORE CHAR AT HL LOCATION
00C4  BE                CP(HL)          ;VERIFY CHAR STORED
00C5  20 06             JR NZ,WARN      ;IF OUT OF RAM WARN
00C7  23                INC HL          ;INCREASE RAM POINTER
00C8  CD 008E           CALL SENDCON    ;DISPLAY CHAR
00CB  18 D5             JR STOPFIL?
00CD  2B        WARN:   DEC HL  ;SET HL TO EOT
00CE  36 06             LD(HL),06       ;WRITE EOT MARKER
00D0  C3 0E04           JP WARM ;WARN USER BY STARTING BASIC
                        ;ECHO ROUTINE
00D3  CD 0043 ECHO:     CALL FEEDER     ;GET CHAR AND CHECK FOR END OF RAMFILE
00D6  CD 0084           CALL SENDEXT    ;SEND CHAR TO REMOTE SYSTEM
00D9  CD 0A46 ECHOLOOK:CALL IST1        ;LOOK FOR ECHO
00DC  28 08             JR Z,RECEIVE    ;IF READY SHOW CHAR
00DE  CD 0AF1           CALL 0AF1H      ;CHECK CONSOLE FOR ^C
00E1  CA 0056           JP Z,RESTOR
00E4  18 F3             JR ECHOLOO      ;WAIT FOR ECHO
00E6  DB 04     RECEIVE:IN A,(04)
00E8  CD 008E           CALL SENDCON    ;SHOW CHAR
00EB  18 E6             JR ECHO
                        .DEPHASE
```

```
                        TITLE EOT
                        ;FIND EOT MARKER:06H
                        ;DE=START ADDRESS FROM NSCOM
0010                    .RADIX 16
                        .Z80
                        .PHASE 0EEH     ;THIS ROUTINE RELOCATES
00EE  EB                 EX DE,HL        ;HL=DE=RAMFILE START
00EF  23        SEARCH: INC HL
00F0  7E                LD A,(HL)       ;A=CHAR
00F1  FE 06             CP 06H  ;IS IT THE EOT?
00F3  20 FA             JR NZ,(SEARCH)
00F5  C9                RET     ;PASS HL TO BASIC
                        .DEPHASE
```

Listing 7.

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Here's a bit of Sorcerer magic that lets you use monitor commands in BASIC programs.

The Sorcerer Reveals Hidden Commands

By C. Kevin McCabe

The Exidy Sorcerer hides processing routines for 14 monitor commands deep within its 2716 PROMs. With a few waves of the Sorcerer's magic wand, a majority of these commands can also be used without change within BASIC programs.

Along with other operations, there are monitor routines to:

- configure the Sorcerer's input/output by selection of appropriate monitor- or user-supplied drivers;
- load, move, inspect, save and execute machine code and data;
- test RAM memory bit-by-bit; and
- specify prompt characters and tape header information.

Each of these commands can be specified in a BASIC string variable, along with any necessary or optional parameters, as shown in Table 1. The utility subroutines in Listing 1 place the command string into the monitor's input buffer, then call the appropriate command processor via BASIC's USR statement. On completion of the command—which might change an output driver, obtain data from the keyboard or execute a machine-language routine in RAM—control jumps back to the BASIC program.

The result is full control over I/O processing and many other monitor functions within BASIC programs. A related benefit arises from use of standard monitor commands and parameters, making the BASIC software nearly self-documenting.

To understand this bit of Sorcerer magic, let's take a closer look at the monitor's organization. In addition to the 4K of PROM beginning at E000H, the top 176 (B0H) bytes of RAM are dedicated to the monitor. The upper 111 (6FH) bytes of this area serve as a scratchpad RAM work area.

Assume that MRAM is the lowest address in this 111 byte RAM work area. What's hidden at MRAM and the following bytes? Lots of goodies! There are bytes to specify I/O driver routine addresses, tape header information, cassette tape and motor status, output delay and input prompt and cursor location. Whenever a monitor command requires such information to perform its function, or changes one of the parameters, the appropriate RAM location in the work area is read or updated.

Certainly, a BASIC program could PEEK and POKE about in the work area to change I/O devices, for example—but that's the hard way. Even

Address	Command	Function
E4D3	DU XXXX [YYYY]	Display contents of memory.
E538	EN XXXX	Load hex byte into memory.
E597	GO XXXX	Execute program at XXXX.
E78A	LO [name] [U] [XXXX]	Load file from tape U.
E562	MO XXXX YYYY [S] [ZZZZ]	Copy memory block-to-block
E845	PR = X	Change to specified prompt.
E638	SA [name] XXXX YYYY [U]	Save memory on tape U.
E5A2	SE F = XX	Set file type header byte.
	I = K	Input from keyboard.
	= P	Input from parallel port
	= S	Input from serial port.
	= XXXX	Input via driver at XXXX.
	O = L	Output to Centronics
	= P	Output to parallel port
	= S	Output to serial port
	= V	Output to video screen
	= XXXX	Output via driver at XXXX.
	S = XX	Set display delay to XX.
	T = X	Data rate = 300 [X = 1], 1200 [0].
	X = XXXX	Set autoexecute address.

Table 1. Sorcerer monitor commands.

Address correspondence to C. Kevin McCabe, 115 South LaSalle, Suite 3300, Chicago, IL 60603.

worse, that method is almost incomprehensible within a BASIC program. The BASIC statements POKE MRAM +63,147: POKE MRAM+64,233 may select the Centronics output driver, but they don't convey that meaning to the programmer as readily as the monitor's equivalent SET 0=L command.

A Better Way

There must be a better way—and there is. The secret lies in the 60 bytes beginning at MRAM which form the monitor's input buffer. When keys are struck following a monitor prompt, the ASCII value of each input character is placed left-justified in the buffer. A carriage return (13 decimal, or 0DH) terminates the monitor's input routine.

A portion of the warm start processor WARM checks the first two bytes in the buffer against a PROM table containing the command characters. If a match is found, the monitor jumps to the associated command processor code and executes the command. If there's no match, an error message is output instead. In either event, a return address is first pushed onto the stack; all processor and error routines end with a Z-80 return command, which pulls the address from the stack and makes an unconditional jump back into WARM.

But why use the keyboard to enter commands? A BASIC program can easily poke ASCII values into the input buffer. Lines 30000-30030 in Listing 1 take the string specified by CMD$ and place it, along with an added carriage return character, in the input buffer beginning at MRAM. So far, so good—but there are two possible hitches.

The first problem is finding the elusive MRAM; since the work area lies at the top of installed memory, MRAM varies from Sorcerer to Sorcerer. However, the monitor provides a machine-independent solution. On each cold start, the monitor tests memory locations for usability, beginning at location 0000H. When the first unusable location is found (by failure of a location to receive and hold a test value) the monitor assumes that it has exceeded installed memory. An address counter is decremented by one, then the resulting 16-bit address is stored at 0F000-0F001H. As is usual with Z-80 operations, the low-order byte is stored in the lower location.

Lines 40000-40030 in Listing 1 calculate MRAM by PEEKs to those locations. For systems with more than 32K of installed memory, the subroutine also converts the resulting decimal address to the necessary negative form.

Ideally, the monitor's own parser in the WARM routine would be used to identify and execute the command poked into the buffer. The second possible hitch comes from the behavior of the monitor after execution of the command. To be useful in a BASIC program, the monitor commands should execute and then return control to BASIC. However, entry into the command processors through WARM causes a return to WARM, not BASIC.

The solution is BASIC's USR command, which executes the machine code at a specified address, then returns control to BASIC. The two bytes at 260-261 (104-105H) are used as a jump vector to the address of the desired code routine. A call to USR jumps to the specified code and begins execution; when a return is encountered, BASIC regains control.

Summary

That gives the final ingredient to the Sorcerer's brew. In addition to the text of the desired monitor command, the program uses another string with the appropriate processor address from Table 1. Lines 10000-20020 convert the four digits of a hex address string to decimal, and POKE them into the two-byte USR hook.

Mixed together, these ingredients provide easy BASIC control of monitor functions. MRAM is found by an initial call to line 40000. The desired monitor function is specified by an equate to the string CMD$; the address of the desired processor is equated to CP$. A call to line 20000 converts and shifts the strings to the proper locations, transfers control to the processor, then retakes command on completion. Additional monitor commands can follow, if desired.

Listing 2 illustrates use of this process. Notably, the program logic is clear even without the remark statements. The first 256 bytes of memory are output to the Centronics printer, then saved at 300 bits per second on tape unit 1. New values are input to the same area of memory from tape unit 2, at 1200 bits per second. Those values—which must terminate with a Z-80 return command of 0C9H—are executed, and control returns to BASIC for the final video message.

All that with only a few equates and subroutine calls—and it's nearly self-documenting to boot. That's powerful magic from your Sorcerer! ■

```
10000 REM--Convert hex address byte to decimal equivalent
10010 VHI = ASC(LEFT$(HEX$,1))-48: IF VHI>9 THEN VHI = VHI-7
10020 VLO = ASC(RIGHT$(HEX$,1))-48: IF VLO>9 THEN VLO = VLO-7
10030 VDEC = 16 * VHI + VLO: RETURN
20000 REM--Poke hex address equivalent into USR hook
20010 HEX$ = LEFT$(CP$,2): GOSUB 10000: POKE 261, VDEC
20020 HEX$ = RIGHT$(CP$,2): GOSUB 10000: POKE 260, VDEC
30000 REM--Poke monitor command into monitor RAM & execute it
30010 CMD$ = CMD$+CHR$(13): FOR J=0 TO LEN(CMD$)-1
30020 POKE J+MRAM, ASC(MID$(CMD$,J+1,1)): NEXT J
30030 J = USR(J): RETURN
40000 REM--Locate first byte of monitor work area
40010 MRAM = 256 * PEEK(-4095) + PEEK(-4096)
40020 IF MRAM > 32767 THEN MRAM = MRAM - 65536
40030 MRAM = MRAM - 110: RETURN
```

Listing 1. Utility subroutines.

```
100 REM--Example program (requires use of Listing 1 routine)
110 GOSUB 40000: REM--Find MRAM = location of input buffer
120 CMD$="SE O=L": CP$="E5A2": GOSUB 20000: REM--Centronics out
130 CMD$="DU 0 FF": CP$="E4D3": GOSUB 20000: REM--Dump memory
140 CMD$="SE O=V": CP$="E5A2": GOSUB 20000: REM--Video out
150 CMD$="SE T=1": GOSUB 20000: CMD$="SA XAMPL 0 FF"
160 CP$="E638": GOSUB 20000: REM--Save memory at 300 baud
170 CMD$="SE T=0": CP$="E5A2": GOSUB 20000: REM--Set 1200 baud
180 CMD$="LO 2 0 FF": CP$="E78A": GOSUB 20000: REM--Load memory
190 CMD$="GO 0": CP$="E597": GOSUB 20000: REM--Execute code
200 PRINT "Tha..tha..tha..that's all, folks!": END
```

Listing 2. Example program.

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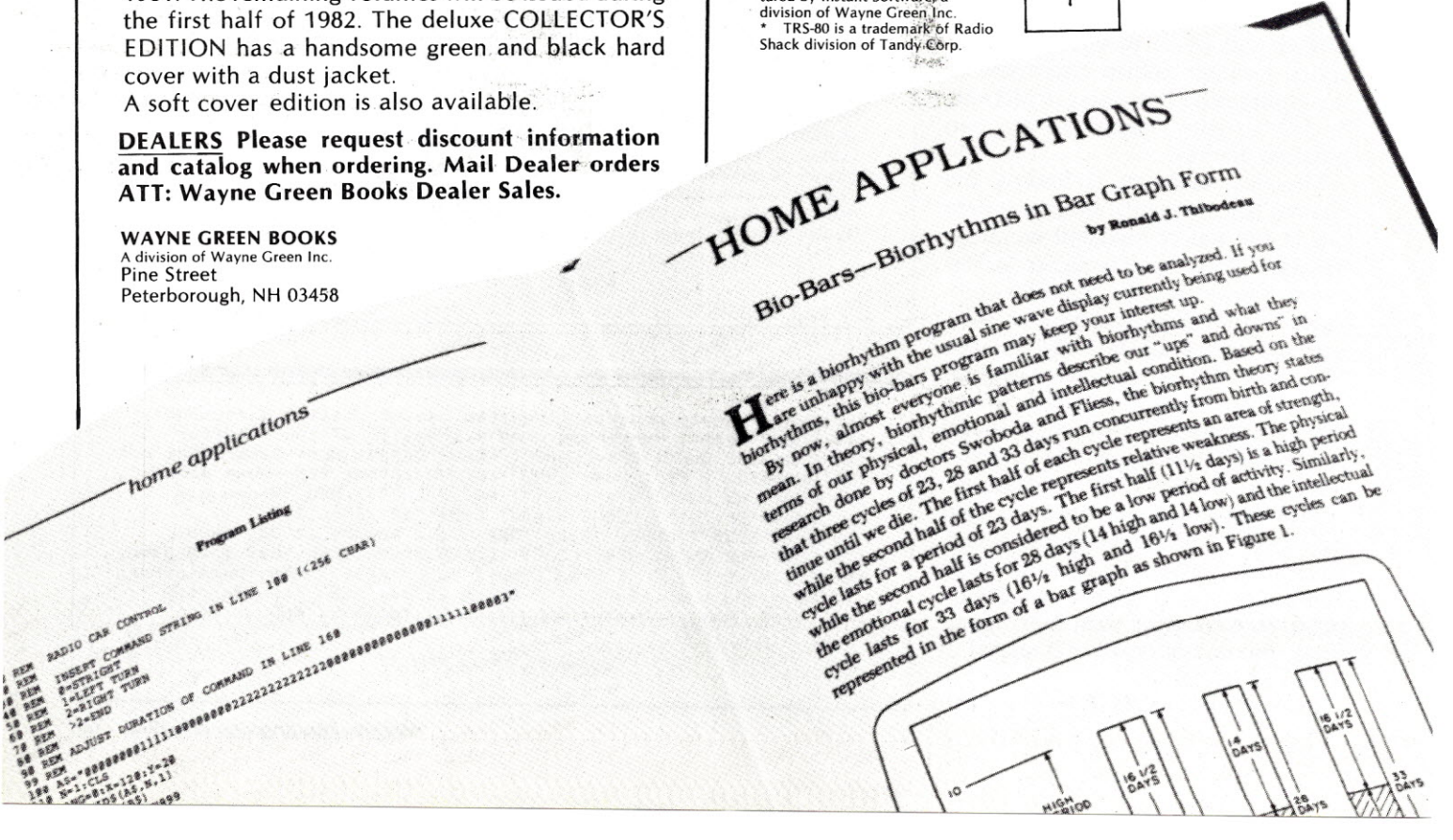

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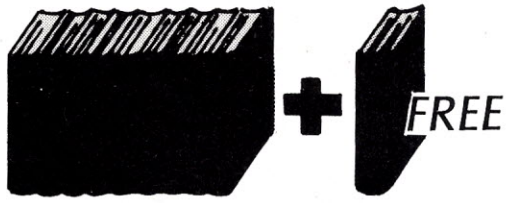

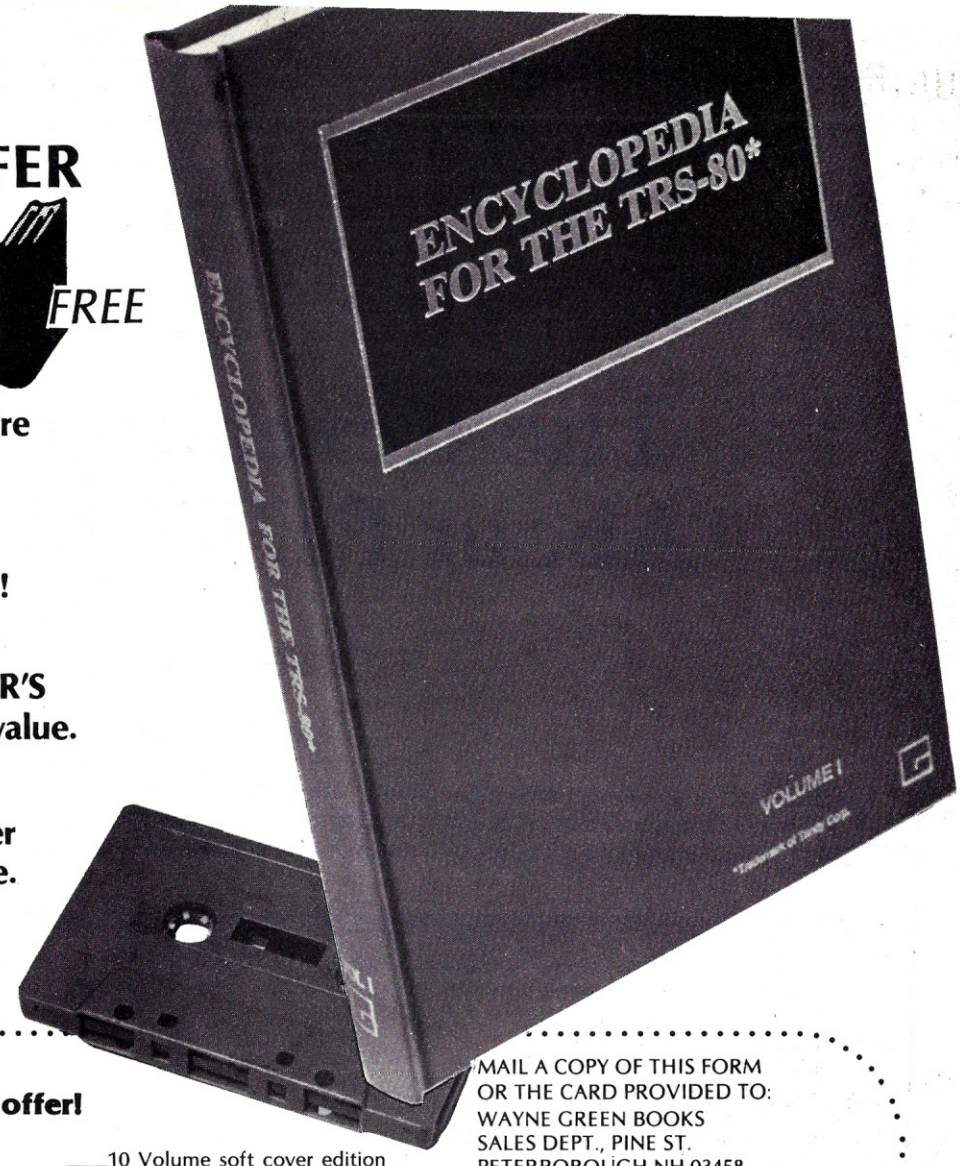

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KBE1

This BASIC text disassembler gives new meaning to the word versatility when programming the PET.

The Revealing Truth About PET's Memory

By Charles R. Trahan

While writing a CBM 2001 program to create files on a CGRS PEDISK, I ran into a common problem. The PEDISK operating system requires you to specify the maximum number of records when a new file is opened. I wanted the user to be able to specify this parameter and have it allocated dynamically in my program. But the DOS requires a numeric constant, not a variable.

The problem could be easily solved with Commodore's BASIC by having the user input the number of records he will require and then poking the ASCII equivalent of the input into the correct location in the OPEN statement in the program. So I needed to determine the exact memory locations (in decimal) that had to be poked.

The detective work started with the machine-language monitor. I tried to locate the line and statement that opened the new file. This can be done, but it's tricky. PET stores different ASCII codes for the same character in main memory and in screen memory. Not only must you know what to look for, but using the monitor requires hex to decimal conversion.

All this caused me to write MEMSEE. MEMSEE should be loaded before you start writing your new program if you don't have an append utility available. Line numbers start at 50000, so it won't interfere with the program line numbers.

When you want to do some poking in your program, enter the POKE

Program listing. The MEMSEE program for the CBM 2001.

```
49900 REM  *** MEMSEE (MEMORY SEE) ***
49902 :
49904 REM  CHUCK TRAHAN
49906 REM  4 CONGRESS COURT
49908 REM  QUAKERTOWN, PA  18951
49910 REM  215-536-0264
49912 :
49914 REM  APPEND TO END OF BASIC PROG
49916 REM  RUN 50000.
49918 REM  MEMSEE WILL DISASSEMBLE
49920 REM  BASIC CODE IN MEMORY.
49922 :
49990 REM  PROG INIT - USER INPUTS
50000 POKE59468,12:PRINT"HIT S TO STOP":INPUT"HI ADDRESS  .";TP
50001 INPUT"LO ADDRESS  .";AD:AD=AD-1:IFTP=0THENTP=99999:REM TOP DEFAULT
50002 INPUT"STOP @ LN   .";LN:IFAD<1THENAD=1023:REM          BOTTOM DEFAULT
50003 IFLN=0THENLN=99999:INPUT"STOP @ EOT  Y";A$:C=ABS(A$="Y")
50004 INPUT"LISTING     N";A$:L=ABS(A$="Y")
50006 INPUT"HARD COPY   N";A$:A=ABS(A$="Y")
50007 IFATHENINPUT"DEVICE #    4";D:OPEND,D:PRINT#D,CHR$(12):CMDD
50008 PRINT:PRINT"ADDRESS","CONTENT   TEXT":PRINT
50010 :
50011 REM BEGIN DISASSEMBLY - PEEK & CHECK FOR 0
50012 GOSUB62000:IFPKTHEN60000                    CONTAINS OTHER THAN 0
50014 :
50015 REM END OF LINE OR END OF TEXT CHECK
50020 IFPEEK(AD+1)ORPEEK(AD+2)ORAD<1024THEN61000 CHECK FOR 3 0'S OR BELOW BASIC
50030 A$="END OF TEXT":GOSUB63300:REM            3 0'S END OF BASIC TEXT FOUND
50033 REM                                        END OF RUN CHECKS FOLLOW
50034 REM                                        DISPLAY NEXT 2 ADDRESSES
50035 FORI=1TO2:GOSUB62000:A$="-----":GOSUB63300:NEXT:IFCTHEN50045 STOP @ EOT
50040 IFAD<TPTHEN50012                                             NOT @ TOP
50043 :
50044 REM  END OF RUN - TERMINATE ACCORDING TO USER INPUTS
50045 IFLTHENIFDTHENPRINT#D,CHR$(12):CMDD:REM    NEW PAGE FOR HARD COPY LISTING
50050 IFLTHENPRINT:LIST:REM                      PROG LISTING @ END OF RUN
50054 IFDTHENPRINT#D,CHR$(12):CLOSED:REM         CLOSE CHANNEL TO PRINTER
50055 END
50060 :
59999 REM  CHECK IF QUOTES MODE OR PET TOKEN MODE
60000 IFNOTFANDPK>127ANDPK<203THENGOSUB63000:GOTO50040  NOT IN QUOTES MODE
60001 IFPK=32ORPK=160THENA$="":GOTO60019                SPACE OR SHIFTED SPACE
60002 IFPK=13ORPK=141THENA$="CARRIAGE RETURN":GOTO60019 CARRIAGE RETURN CHAR.
60003 A$=CHR$(PK):IFPK>29THEN60010                      ASCII CHAR. ASSIGNED
60004 IFPK=29THENA$="CURSOR >":GOTO60019                PEEK>29 IS SPECIAL CHAR
60005 IFPK<17ORPK>20THEN60019                           NOT IN 'SPECIAL' RANGE
60006 A$="CURSOR V":IFPK>17THENA$="REVERSE ON":IFPK>18THENA$="CURSOR HOME
60007 IFPK>19THENA$="DELETE":REM                        PET'S 'DELETE' KEY
60008 GOTO60019
60009 :
60010 IFPK=131THENA$="RUN":GOTO60019                    SPECIAL CASE ASCII'S
60011 IFPK=157THENA$="CURSOR _":GOTO60019               THESE 2 ARE ODD NUMBERS
60012 IFPK<145ORPK>148THEN60019                         NORMAL ASCII CHAR.
60013 A$="CURSOR ^":IFPK>145THENA$="REVERSE OFF":IFPK>146THENA$="CLEAR SCREEN
60014 IFPK>147THENA$="INSERT":REM                       PET'S 'INSERT' KEY
60019 GOSUB63300:GOTO50040                              PRINT RESULTS & CONT.
```

More

Address correspondence to Charles R. Trahan, 4 Congress Court, Quakertown, PA 18951.

command with a dummy address; i.e., POKE 0000,32 then RUN 50000. An examination of the printout (or carefully watching the CRT display) will yield the exact decimal address of interest.

There are a couple of bonuses to running MEMSEE. You will learn how the PET stores your program in memory. The end-of-line marker, link-to-next-line and line numbers become easy to see. In the PET's memory what you see is not always what you get. For instance, BASIC commands are stored as one-byte tokens. MEMSEE displays what's in memory in decimal, and what it really means to the programmer.

In addition to viewing your BASIC text, you can examine the operating system's working space, addresses 512 to 634, and you'll see your last-used strings residing there. You can look at the top of user's memory where strings are stored, or just above BASIC text where variables are stored. You may be able to recall lost data this way.

Running the Program

Slightly less than 3K bytes are required for MEMSEE. Even the longest BASIC program usually sets aside at least this amount for string storage and arrays, so MEMSEE can be appended to the end of most programs and deleted when no longer required. Admittedly, this is tedious if you have no DELETE utility. When you first load or append MEMSEE you should remove the REM statements.

When you RUN 50000, you'll see the prompt HIT S TO STOP. Runs get rather lengthy so you have the option of terminating them at any time with the S key. Don't use the stop key or files won't be closed.

The prompts HI ADDRESS, LO ADDRESS will appear next. Enter any decimal addresses you want.

The next prompt, STOP @ LN, is asking for a line number at which to end the run. Hitting RETURN will default to 99999, this being greater than any possible line number. The line number you enter does not have to actually be in your program. The run will terminate when the line number in memory is greater than the one you entered.

If you default on line number, you will be asked STOP @ EOT. This stands for end of BASIC text. Respond with Y or N. Remember, if you stop at EOT rather than a line num-

Listing continued.

```
60998 :
60999 REM  CALCULATE LINK & LINE NUMBERS
61000 IFAD<1024THENA$="-----":GOSUB63300:GOTO50012      BELOW BASIC - INVALID
61002 F=0:A$="END OF LINE":IFAD=1024THENA$="START BASIC TEXT
61005 GOSUB63300:GOSUB62000:A$="LINK"+STR$(PK+256*PEEK(AD+1)):GOSUB63300
61007 GOSUB62000:A$="-----":GOSUB63300
61010 GOSUB62000:P=PK+256*PEEK(AD+1):A$="LINE #"+STR$(P):GOSUB63300
61015 IFP=>LNTHEN50045                                  CHECK FOR ENDING LINE#
61020 GOSUB62000:A$="-----":GOSUB63300:GOTO50012
61021 :
61999 REM  LOOK @ PET'S MEMORY HERE
62000 AD=AD+1:PK=PEEK(AD):GETK$:IFDTHENCMDD:REM         BUMP ADDRESS & PEEK IT
62010 IFK$="S"THEN50045                                 CHECK FOR STOP 'S' KEY
62015 IFPK=34THENF=NOTF:REM                             KEEP TRACK OF QUOTES
62020 RETURN
62021 :
62090 REM  BASIC TOKEN LOOK-UP TABLE
63000 A$="END":IFPK>128THENA$="FOR":IFPK>129THENA$="NEXT":IFPK>130THENA$="DATA
63020 IFPK>131THENA$="INPUT#":IFPK>132THENA$="INPUT":IFPK>133THENA$="DIM
63030 IFPK>134THENA$="READ":IFPK>135THENA$="LET":IFPK>136THENA$="GOTO
63040 IFPK>137THENA$="RUN":IFPK>138THENA$="IF":IFPK>139THENA$="RESTORE
63050 IFPK>140THENA$="GOSUB":IFPK>141THENA$="RETURN":IFPK>142THENA$="REM
63060 IFPK>143THENA$="STOP":IFPK>144THENA$="ON":IFPK>145THENA$="WAIT
63070 IFPK>146THENA$="LOAD":IFPK>147THENA$="SAVE":IFPK>148THENA$="VERIFY
63080 IFPK>149THENA$="DEF":IFPK>150THENA$="POKE":IFPK>151THENA$="PRINT#
63090 IFPK>152THENA$="PRINT":IFPK>153THENA$="CONT":IFPK>154THENA$="LIST
63100 IFPK>155THENA$="CLR":IFPK>156THENA$="CMD":IFPK>157THENA$="SYS
63110 IFPK>158THENA$="OPEN":IFPK>159THENA$="CLOSE":IFPK>160THENA$="GET
63120 IFPK>161THENA$="NEW":IFPK>162THENA$="TAB(":IFPK>163THENA$="TO
63125 IFPK>164THENA$="FN
63130 IFPK>165THENA$="SPC(":IFPK>166THENA$="THEN":IFPK>167THENA$="NOT
63140 IFPK>168THENA$="STEP":IFPK>169THENA$="+":IFPK>170THENA$="-
63145 IFPK>171THENA$="*
63150 IFPK>172THENA$="/":IFPK>173THENA$="^":IFPK>174THENA$="AND
63155 IFPK>175THENA$="OR
63160 IFPK>176THENA$=">":IFPK>177THENA$="=":IFPK>178THENA$="<
63165 IFPK>179THENA$="SGN
63170 IFPK>180THENA$="INT":IFPK>181THENA$="ABS":IFPK>182THENA$="USR
63175 IFPK>183THENA$="FRE
63180 IFPK>184THENA$="POS":IFPK>185THENA$="SQR":IFPK>186THENA$="RND
63185 IFPK>187THENA$="LOG
63190 IFPK>188THENA$="EXP":IFPK>189THENA$="COS":IFPK>190THENA$="SIN
63195 IFPK>191THENA$="TAN
63200 IFPK>192THENA$="ATN":IFPK>193THENA$="PEEK":IFPK>194THENA$="LEN
63210 IFPK>195THENA$="STR$":IFPK>196THENA$="VAL":IFPK>197THENA$="ASC
63220 IFPK>198THENA$="CHR$":IFPK>199THENA$="LEFT$":IFPK>200THENA$="RIGHT$
63230 IFPK>201THENA$="MID$":IFPK>202THENA$="------":IFPK=255THENA$=CHR$(222)
63231 :
63299 REM  DISPLAY RESULTS HERE
63300 PRINTAD,PK;SPC(10-LEN(STR$(PK)))A$;:IFD=0THENPRINT
63310 RETURN
```

```
1015        0       -----
1016        0       -----
1017        0       -----
1018        247       -
1019        231       |
1020        4
1021        207       ┌
1022        0       -----
1023        142       RETURN
1024        0       START BASIC TEXT
1025        55       LINK 1079
1026        4       -----
1027        80       LINE # 50000


3772        0       END OF LINE
3773        211       LINK 3795
3774        14       -----
3775        68       LINE # 63300
3776        247       -----
3777        153       PRINT
3778        65       A
3779        68       D
3780        44       ,
3781        80       P
3782        75       K
3783        44       ,
3784        65       A
3785        36       $
3786        59       ;
3787        58       :
3788        139       IF
3789        68       D
3790        178       =
3791        48       0
3792        167       THEN
3793        153       PRINT
3794        0       END OF LINE
3795        217       LINK 3801
3796        14       -----
3797        78       LINE # 63310
3798        247       -----
3799        142       RETURN
3800        0       END OF TEXT
3801        0       -----
3802        0       -----
```

Sample run. Starts below BASIC text, terminates at line 50000 and is rerun from address 3772 to the end of text.

ber, MEMSEE will be included in the disassembly.

Answer Y or N to LISTING. If you answer yes, a program listing will be given at the end of run. When the listing is complete, type GOTO 50054 and RETURN to properly close all files.

If you answered no, you will be asked if you want hard copy. A yes answer to either question will cause the prompt DEVICE # to be displayed. This permits hard copy to any printer.

After device #, or a no answer to the listing and hard copy prompts, the run will start. If your display is on the screen, it will scroll at a fairly readable rate. The S key will end the listing immediately, or use the stop key and CONT command to freeze the display. The scroll can be slowed down with the OFF/RVS key in the usual manner.

Program Description

A poke to graphics mode in line 50000 is required for a correct printout. Parameters are then entered in lines 50000 to 50008.

Line 50010 determines if a 0 was found marking the end of a line. Line 50020 then checks for two more 0's marking the end of BASIC text.

If no 0's were found, the program branches to line 60000. The variable F indicates quotes mode and determines if peeks greater than 127 will be tokens (numeric values representing BASIC commands) or special PET characters such as cursor control. The proper token is looked up in lines 63000 to 63230 or the special character in lines 60001 to 60014. Values failing the special character check are assigned as ASCII in line 60003.

If an end-of-line 0 was found, but not followed by two more 0's, a branch is taken (line 50020) to line 61000. This is where the link and line numbers are calculated and displayed.

One special case is when the address is below 1024, start of BASIC. This is handled in lines 50020 to 61000. Addresses above the BASIC storage area will be seen as BASIC and print mostly nonsense, but string and variable storage should still be apparent.

Type in the program and try a run. You will see it disassemble itself.■

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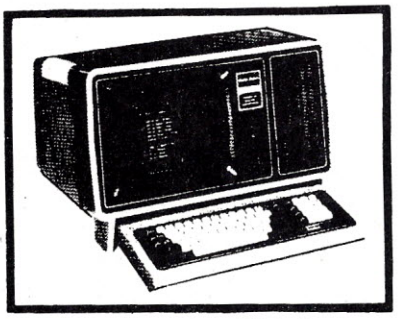

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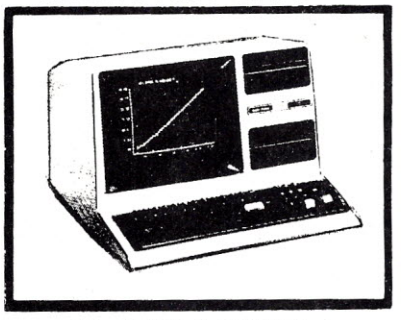

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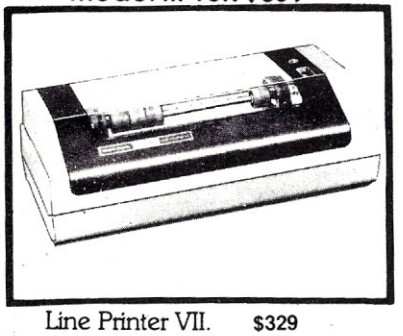

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Change those North Star backslashes to colons and commas to semicolons before printing a listing—in three seconds or less!

Backslashes to Colons

By John A. Bryant

North Star BASIC makes unusual use of such delimiters as the backslash and the comma. While many BASICs use the comma and the semicolon, North Star uses only the comma and gives it the meaning other BASICs attach to the semicolon. Also, in North Star the backslash is used instead of the colon to separate statements on the same line.

To add to all the confusion, my printer doesn't recognize a backslash. So before I send a listing to someone, I have to put in colons or backslashes by hand and change all the commas to semicolons.

It occurred to me that someone with a computer shouldn't be doing all that tedious work, so I dashed off an assembly-language program to quickly make the changes. The program was suggested by Rinaldo Prisco's space remover program in the January 1981 *Mircocomputing* (p. 40).

My program, like Prisco's, operates on the BASIC program while it is in memory, and thus is lightning-fast. It should be assembled to load at some free area that will not be occupied by the BASIC program—either high memory or below DOS. When it finishes its work, it returns you to BASIC, and the modified program can be either directed to the screen or printer with the LIST command, or saved to disk for later printing.

Address correspondence to John A. Bryant, 6648 N. Canandaigua Road, Holcomb, NY 14469.

How It Works

The program examines each byte of the BASIC program in memory and checks to see if it is a backslash (5C in hexadecimal) or a comma (2C). If the byte does represent one of those characters, it is replaced by the appropriate character, by means of a move immediate (MVI) instruction.

Remarks and matter within quotes or parentheses branch to the REM, QUOTE and PAREN routines, so that commas there are not changed. However, since my printer won't print a backslash, I designed the program to convert backslashes to colons no matter where they are found.

The SKIP routine is used to skip over line-number references, since they may contain the hexadecimal values of a backslash or a comma. North Star BASIC uses a 1 to mark the end of the program, so line 180 checks to see if the end of the program in memory has been reached, in which case a jump is made to an entry point for BASIC (line 170).

Entering the Program

The program is short; anyone with an assembler can enter it quickly using assembly-language mnemonics, and can then assemble it at any location. Note that the hex value at line 130 represents the last byte of BASIC, and the value at line 170 is a BASIC entry point. The values given are for release 5.0; if you are using a different version, you'll have to enter the appropriate values.

Even if you don't have an assembler and don't know assembly language from Latin, you can still enter and use this program.

The right-hand two-thirds of Listing 1 shows the assembly-language coding with remarks; the left columns represent the assembled version, assembled at 0000H. Listing 2 shows just the assembled version, assembled not at 0000H, but at the top of memory in a 32K machine with memory from 2000H to 9FFFH. Note that the four hexadecimal digits at the far left are the memory locations where the values shown at the immediate right are stored. When there is one two-digit value to the right, the memory locations increment by one; when there are two, the next location is incremented by two, and so on.

With that background, here's how to enter and save this program without an assembler:

- Decide whether you want to locate the program at 0000H or at 9F8BH.
- Load one of North Star's monitors at a location that will not overlap DOS or the area where the program is to be placed.
- Use the DS (display storage) feature of the monitor. If you're assembling at 0000H, enter DS 0, followed by a carriage return (otherwise, enter DS 9F8B, then the carriage return). The monitor will display the value at that location, followed by an

equals sign.

●You then enter 21, press the space bar (not the carriage return), 9D, space bar, 5F, space bar, 23, space bar, and so on until you get to the end of the assembly listing, at which time you should press the carriage return. (Actually, at lines 130 and 170 you should enter the appropriate values for your version of North Star BASIC, as explained above. Note that when you're using the monitor they are entered backwards, that is, 5F9D would be entered 9D 5F.)

●Return to DOS by entering OS (Operating System), followed by a carriage return.

●Now create a file on a disk to hold the program by using the DOS CR and TY commands. For example, enter CR REPLACE 2 (carriage return), then TY REPLACE 1 0 (carriage return) or TY REPLACE 1 9F8B (carriage return), depending on where you located it.

●Finally, type SF REPLACE 0 (carriage return) or SF REPLACE 9F8B (carriage return), as the case may be.

```
0000                    0010 ;            REPLACE
0000                    0020 ;
0000                    0030 ;  FOR NORTH STAR BASIC PROGRAMS
0000                    0040 ;
0000                    0050 ;
0000                    0060 ;CHANGES BACKSLASHES TO COLONS,
0000                    0070 ;CHANGES DELIMITER COMMAS TO SEMICOLONS.
0000                    0080 ;
0000                    0090 ;HEX VALUE AT LINE 130 IS LAST BYTE OF BASIC.
0000                    0100 ;HEX VALUE AT LINE 170 IS ENTRY POINT OF BASIC.
0000                    0110 ;
0000                    0120 ;
0000 21 9D 5F           0130        LXI   H,5F9DH       ;LAST BYTE OF BASIC
0003 23                 0140 NEW    INX   H             ;SKIP BYTE FOR # CHRS/LINE
0004 7E                 0150        MOV   A,M           ;PUT VALUE AT H IN A
0005 FE 01              0160        CPI   1             ;END OF PROGRAM?
0007 CA 04 2D           0170        JZ    2D04H         ;YES-JUMP TO BASIC
000A 23                 0180 SKIP   INX   H             ;SKIP OVER LINE NO.
000B 23                 0190        INX   H
000C 23                 0200 CHECK  INX   H             ;GO TO NEXT BYTE
000D 7E                 0210        MOV   A,M
000E FE 9A              0220        CPI   9AH           ;REFERENCED LINE NO.?
0010 CA 0A 00           0230        Z     SKIP
0013 FE 0D              0240        CPI   0DH           ;END OF LINE?
0015 CA 03 00           0250        JZ    NEW
0018 FE 8F              0260        CPI   8FH           ;REMARK?
001A CA 3B 00           0270        JZ    REM
001D FE 22              0280        CPI   22H           ;QUOTE?
001F CA 4C 00           0290        JZ    QUOTE
0022 FE E0              0300        CPI   0E0H          ;LEFT PARENTHESIS?
0024 CA 62 00           0310        JZ    PAREN
0027 FE 2C              0320        CPI   2CH           ;COMMA?
0029 C2 31 00           0330        JNZ   NEXT
002C 36 3B              0340        MVI   M,3BH         ;SUBSTITUTE A SEMICOLON
002E C3 0C 00           0350        JMP   CHECK
0031 FE 5C              0360 NEXT   CPI   5CH           ;BACKSLASH?
0033 C2 0C 00           0370        JNZ   CHECK
0036 36 3A              0380        MVI   M,3AH         ;SUBSTITUTE A COLON
0038 C3 0C 00           0390        JMP   CHECK
003B 23                 0400 REM    INX   H             ;ROUTINE FOR REMARKS
003C 7E                 0410        MOV   A,M
003D FE 0D              0420        CPI   0DH           ;END OF LINE?
003F CA 03 00           0430        JZ    NEW
0042 FE 5C              0440        CPI   5CH           ;BACKSLASH?
0044 C2 3B 00           0450        JNZ   REM
0047 36 3A              0460        MVI   M,3AH         ;SUBSTITUTE A COLON
0049 C3 0C 00           0470        JMP   CHECK
004C 23                 0480 QUOTE  INX   H             ;ROUTINE FOR CHARS.
004D 7E                 0490        MOV   A,M           ;WITHIN QUOTES
004E FE 22              0500        CPI   22H           ;QUOTE CLOSED?
0050 CA 0C 00           0510        JZ    CHECK
0053 FE 0D              0520        CPI   0DH           ;END OF LINE?
0055 CA 03 00           0530        JZ    NEW
0058 FE 5C              0540        CPI   5CH           ;BACKSLASH?
005A C2 4C 00           0550        JNZ   QUOTE
005D 36 3A              0560        MVI   M,3AH         ;SUBSTITUTE A COLON
005F C3 4C 00           0570        JMP   QUOTE
0062 23                 0580 PAREN  INX   H             ;ROUTINE FOR CHARS.
0063 7E                 0590        MOV   A,M           ;WITHIN PARENTHESES
0064 FE 29              0600        CPI   29H           ;PARENTHESES CLOSED?
0066 CA 0C 00           0610        JZ    CHECK
0069 FE 0D              0620        CPI   0DH           ;END OF LINE?
006B CA 03 00           0630        JZ    NEW
006E FE 5C              0640        CPI   5CH           ;BACKSLASH?
0070 C2 62 00           0650        JNZ   PAREN
0073 36 3A              0660        MVI   M,3AH         ;SUBSTITUTE A COLON
0075                    0670        END                 ;END

SYMBOL TABLE

CHECK 000C   NEW   0003   NEXT  0031   PAREN 0062   QUOTE 004C
REM   003B   SKIP  000A
```

Listing 1. Replace program in assembly language for North Star BASIC.

Using REPLACE

Any time you wish to modify a BASIC program for printing, load BASIC, load the program to be modified, use BYE to drop into the DOS, then type GO REPLACE (carriage return). Quick as a wink, the program will be modified and you will return to BASIC, where you can either list the modified program to the screen or printer or save it to disk. To modify additional programs once REPLACE has been loaded, merely load the program to be modified, press control-C, then enter JP 0 or JP 9F8B. Again, the program will be modified and you'll be back in BASIC in a flash.

This program is so fast that if you haven't been returned to BASIC and the READY prompt hasn't been printed within about three seconds after running REPLACE, something is wrong. You should reboot (press reset) and check to make sure REPLACE has been entered correctly and the other steps have been followed correctly.

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reference to using REPLACE. If you edit any line of the BASIC program after running REPLACE on it, any semicolons or colons in that line will be changed back to commas or backslashes by routines within BASIC. While that can be prevented by a couple of FILLs, it is easier to just run REPLACE again.■

```
9F8B 21 9D 5F
9F8E 23
9F8F 7E
9F90 FE 01
9F92 CA 04 2D
9F95 23
9F96 23
9F97 23
9F98 7E
9F99 FE 9A
9F9B CA 95 9F
9F9E FE 0D
9FA0 CA 8E 9F
9FA3 FE 8F
9FA5 CA C6 9F
9FA8 FE 22
9FAA CA D7 9F
9FAD FE E0
9FAF CA ED 9F
9FB2 FE 2C
9FB4 C2 BC 9F
9FB7 36 3B
9FB9 C3 97 9F
9FBC FE 5C
9FBE C2 97 9F
9FC1 36 3A
9FC3 C3 97 9F
9FC6 23
9FC7 7E
9FC8 FE 0D
9FCA CA 8E 9F
9FCD FE 5C
9FCF C2 C6 9F
9FD2 36 3A
9FD4 C3 97 9F
9FD7 23
9FD8 7E
9FD9 FE 22
9FDB CA 97 9F
9FDE FE 0D
9FE0 CA 8E 9F
9FE3 FE 5C
9FE5 C2 D7 9F
9FE8 36 3A
9FEA C3 D7 9F
9FED 23
9FEE 7E
9FEF FE 29
9FF1 CA 97 9F
9FF4 FE 0D
9FF6 CA 8E 9F
9FF9 FE 5C
9FFB C2 ED 9F
9FFE 36 3A
A000

SYMBOL TABLE

CHECK 9F97   NEW   9F8E
REM   9FC6   SKIP  9F95
NEXT  9FBC   PAREN 9FED
QUOTE 9FD7
```

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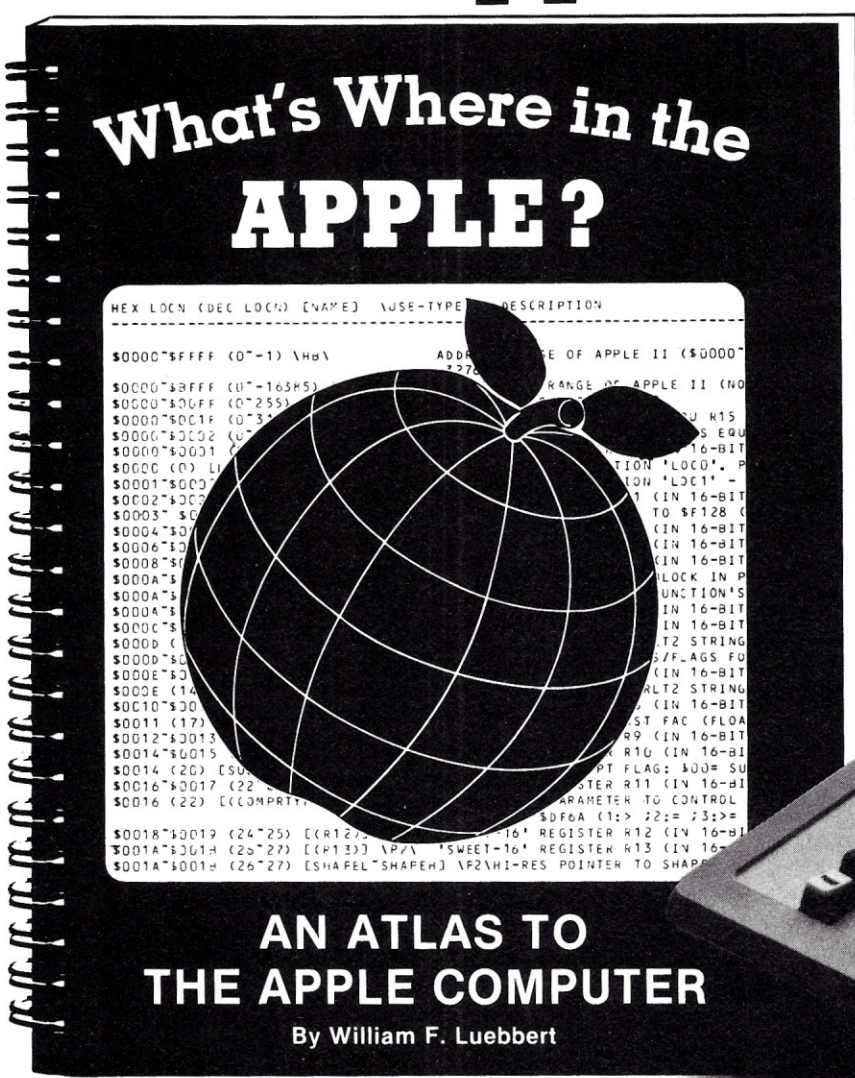

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Maximum Profit

Suppose your company manufactures products A and B at a profit of $50 and $75, respectively. You know that department 1 takes ten hours to make product A and six hours to make product B. Department 2 requires five hours to make product A and 14 hours to make product B. Department 1 has no more than 200 man-hours available per day. Department 2 has no more than 300 man-hours per day available. You wish to find the number of units of A and B that should be made to maximize the profit.

Let x be the number of units of product A and y the number of units of product B. The relevant information can be summarized as follows: Maximize $P = 50x + 75y$ subject to $10x + 6y \leqslant 200$ and $5x + 14y \leqslant 300$. Notice that the inequalities restrict x to be no larger than 20 and y to be no larger than 21.

Program listing 1 examines all $20 \times 21 = 420$ feasible solutions in a few seconds and prints the best solution. Line 20 declares the variables to be integers. In line 30 we initialize the variable PM to be less than any possible maximum. Zero is sufficient here since all of the variables are non-negative integers.

The FOR. . . NEXT loops consider the following ordered pairs: (0,0), (0,1), (0,2), . . . ,(0,21), (2,0), (2,1), (2,2), . . . ,(2,21), . . . ,(20,21). The first of these pairs to satisfy the constraints of lines 50 and 60 will get to line 70 and evaluate the P function. Then line 80 compares this P function value with the current value of PM, which is 0. Therefore, P will be larger and is stored in PM (along with the x,y values that produced P), erasing 0. This process continues, and each time a P value is greater than the currently stored PM value (the maximum so far), the program jumps to the storage area and stores the new maximum. Finally, at the end of the program, the current stored maximum is the true maximum, because all possible solutions have been considered.

Minimum Delivery Cost

You have two sources for a product and three locations (A, B and C) where you need supplies. A needs ten units, B needs eight units and C needs 30 units. Source 1 can furnish 30 units and source 2 has 18 units. The cost of delivering one unit from source i to location j is shown in Table 1. How should the 48 units needed be ordered to minimize the cost of delivery?

Let A1 be the number of units from source 1 to location A, A2 the number of units from source 2 to location A and so on. The problem can then be summarized as follows: Minimize $C = 620A1 + 66B1 + 72C1 + 58A2 + 132B2 + 104C2$, subject to $A1 + B1 + C1 = 30$, $A2 + B2 + C2 = 18$, $A1 + A2 = 10$, $B1 + B2 = 8$ and $C1 + C2 = 30$.

```
10 ' pROGRAM 1
20 DEFINT X,Y,P
30 PM=0
40 FOR X=0 TO  20:FOR Y=0 TO 21
50 IF 10*X+6*Y>200 GOTO 90
60 IF 5*X+14*Y>300 GOTO 90
70 P=50*X+75*Y
80 IF P>PM THEN PM=P:XM=X:YM=Y
90 NEXT Y:NEXT X
100 PRINT"THE SOLUTION IS:"
110 PRINT"     X =";XM;", Y =";YM;", AND MAXIMUM P -";PM
120 END
```

Program listing 1. Programs written for the TRS-80.

Address correspondence to Louis C. Graue, 624 Campbell Hill Road, Bowling Green, OH 43402.

From the constraints you can see that A1 must be less than or equal to 10 (A1 + A2 = 10), and B1 must be less than or equal to 8 (B1 + B2 = 8). Also, C1 must be equal to 30 – A1 – B1. A2 must be less than or equal to 10 (A1 + A2 = 10), and B2 must be less than or equal to 8 (B1 + B2 = 8). Also, C2 must equal 18 – A2 – B2 (A2 + B2 + C2 = 18).

Program listing 2 examines all 9801 (11 × 9 × 11 × 9) feasible solutions and takes just over four minutes to complete the problem. By placing the print statement within the loops, each currently stored minimum will be printed (so you will have something to watch while waiting for the solution). The last one printed will be the best solution.

Eight units should be ordered from source 1 for location B; 22 units from source 1 for location C; ten units from source 2 for location A, and eight units from source 2 for location C to minimize the delivery costs, which will be $35.24.

Monte Carlo Programming

If a problem has ten variables and each has only ten values, then you will have 10^{10} cases to examine. At the rate of one set of values per millisecond, 10^7 seconds is required to examine them. This is something more than 10^5 hours, or about ten years. To obtain a solution in a reasonable amount of time, take a random sample of a million feasible solutions and find the optimum of that sample using the same techniques explained above.

How good is the answer obtained by this method? Statistical procedures have been used to show that in any practical problem the answer is nearly optimum. However, even if this were not true, you would still have the best course of action out of millions of decisions. This method may not have been practical in the days when we had to pay dearly for computer time, but many microcomputers are turned off for the majority of the time. If this is the case, they could be working on the Monte Carlo programming problem for part of that time.

To illustrate the Monte Carlo technique, you seek to maximize

$$P = X_1^2 + X_2^2 + 3X_3^2 + 4X_4^2 + 2X_5^2 - 8X_1 - 2X_2 - 3X_3 - X_4 - 2X_5$$

subject to

$X_1 < 100$, $X_2 < 100$, $X_3 < 100$,
$X_4 < 100$, $X_5 < 100$
$X_1 + X_2 + X_3 + X_4 + X_5 < 401$
$X_1 + 2X_2 + 2X_3 + X_4 + 6X_5 < 801$
$2X_1 + X_2 + 6X_3 < 201$
$X_3 + X_4 + 5X_5 < 201$

with all variables non-negative integers.

There are 10 billion sets of values to be checked. Look at a random sample of 1 million points and take the one that gives a maximum P. Examine Program listing 3 and notice that we have not set up a FOR. . . NEXT loop for each variable as we did in the previous examples. We have set up one outside FOR. . . NEXT loop on J running from 1 to 1,000,000. Each time J assumes a new value, line 40 assigns each variable X_1, X_2, X_3, X_4 and X_5 a random value between 0 and 99. This set of values is checked as before, and the current best value is stored in PM. We get a printout of the form (X_1, X_2, X_3, X_4, X_5) PM each time a new maximum is found. This shows the set of values giving the current maximum. The last value printed is the maximum P for the 1 million points checked.

I've run this program three times and the best value optained so far was 50420 at (50, 97, 0, 99, 1).

Conclusion

By following the examples, you should be able to write a program to solve optimization problems. You only need to substitute your function and constraints in place of the ones in the examples. The variables must have integer values. The variable which stores the extreme value must be initialized larger than any possible value of the function if you're seeking the minimum, or smaller than any possible value if you are finding a maximum.

If you wish to learn more about these techniques, I suggest the book *Computer Optimization Techniques* by William Conley (Petrocelli Books, Inc.). It's well written, elementary and contains a large number of examples.■

Delivery Cost

From Source	To Location A	To Location B	To Location C
1	$6.20	$.66	$.72
2	$.58	$1.32	$1.04

Table 1.

```
10 ' PROGRAM 2
15 DEFINT A,B,C
20 CM=32700
30 FOR A1=0 TO 10:FOR B1=0 TO 8:FOR A2=0 TO 10:FOR B2=0 TO 8
40 C1=30-A1-B1:C2=18-A2-B2
50 IF A1+A2<>10 GOTO 110
60 IF B1+B2<>8 GOTO 110
70 IF C1+C2<>30 GOTO 110
80 C=120*A1+66*B1+72*C1+58*A2+132*B2+104*C2
90 IF C<=CM THEN CM=C ELSE 110
100 PRINT A1;B1;C1;A2;B2;C2;  CM
110 NEXT B2:NEXT A2:NEXT B1:NEXT A1
120 END
```

Program listing 2.

```
10 ' PROGRAM 3
20 DIM X(5)
30 PM=0
35 FOR J=1 TO 1000000
40 FOR I=1 TO 5:X(I)=RND(100)-1:NEXT I
50 IF X(1)+X(2)+X(3)+X(4)+X(5)>400 GOTO 200
60 IF X(1)+2*X(2)+2*X(3)+X(4)+6*X(5)>800 GOTO 200
70 IF 2*X(1)+X(2)+6*X(3)>200 GOTO 200
80 IF X(3)+X(4)+5*X(5)>200 GOTO 200
90 P=X(1)*X(1)+X(2)*X(2)+3*X(3)*X(3)+4*X(4)*X(4)+2*X(5)*X(5)-8*X(1)-2*X(2)-
3*X(3)-X(4)-2*X(5)
100 IF P>=PM THEN PM=P ELSE 200
110 PRINT "(";X(1);",";X(2);",";X(3);",";X(4);",";X(5);")  ";PM
200 NEXT J
210 END
```

Program listing 3.

Use the information in a North Star diskette file directory as data. Here's how to access it from BASIC.

Treat Your File Directory As Data

By Stephen Lewis

I run North Star BASIC on my Altair, and use it to keep track of stock prices, interest rates and other data. Several of the programs I've written require me to input the name of a disk file for the program to operate on. But two problems may arise.

First, a typing or file name error, or a failure to remember which drive holds the data disk ends program execution. Second, I may not know the complete file name, only the first one or two characters.

Also, I may wish to get a partial printout of the file directory (e.g., those with file names starting with NV), not the complete directory.

Thus, I need to be able to treat the file directory as data. I could use the ERRSET statement to catch the FILE ERROR IN LINE XXXX message without ending program execution, but this still leaves me guessing what the correct file name is. It also does not help me get my partial printout. I could keep a separate data file on the disk, duplicating the file directory, and update it every time I create or destroy a file. I don't like that method because most of my data files are created by programs and are not in the command mode.

This program, called Quest, solves these problems. I use the statement READ#F,&N as part of the program. F is the number of a file with the name of the disk (the identifier for the four sectors, eight in quad density systems) starting at track 0, sector 0, on the disk. For the diskette supplied by North Star, this is MDQ-R5.1. N is a variable name. The & in front of the N signifies that the file is to be read one byte at a time. This method is necessary because the disk directory is not in the form of BASIC strings or numbers.■

```
WORDPRO DISK ADDR 73
IT IS 48 BLOCKS LONG
SINGLE DENSITY
ITS FILE TYPE IS 7
TYPE DEPENDENT INFORMATION 24 45 32

SEPT DISK ADDR 145
IT IS 6 BLOCKS LONG
ITS FILE TYPE IS 3
TYPE DEPENDENT INFORMATION 8 32 32

BASIC DISK ADDR 10
IT IS 52 BLOCKS LONG
ITS FILE TYPE IS 1
GO ADDRESS IS 11520
TYPE DEPENDENT INFORMATION 0 45 32
```

Sample output.

Address correspondence to Stephen Lewis, 8005 30th St. S.E., Everett, WA 98205.

```
10 REM * * * PROGRAM NAME IS QUEST * * *
15INPUT "DESIRED OUTPUT DEVICE",P
20 INPUT "DISK NAME ",A$
30 INPUT "NAME OF FILE TO LOOK FOR ",A1$
40 IF LEN(A1$)=8 THEN 80
50 IF LEN(A1$)>8 THEN 30 \ REM * * * FILE NAMES ARE 8 CHARACTERS MAXIMUM
60 A1$ = A1$ + " " \REM ADD SPACES TO MAKE UP 8 CHARACTERS
70 IF LEN(A1$)<8 THEN 60
80 OPEN #1%0,A$  \REM THIS OPENS DISK DIRECTORY FILE
90 FOR J = 1 TO 128 \REM * * * 128 FOR A DOUBLE DENSITY DISK
100 FOR I = 1 TO 8
110 READ#1,&X(I) \REM THIS READS THE FILENAME FROM THE DIRECTORY
120 NEXT I
130FOR I=1 TO 8\READ#1,&Y(I)\NEXT I
140A2$="" \REM * * * THE NULL STRING
150 FOR I = 1 TO 8
160 A2$=A2$+ CHR$(X(I)) \ REM * * * THIS REASSEMBLES FILENAME
170 NEXT I
180 IF A2$ = "        " THEN 280 \REM 8 SPACES BETWEEN THE QUOTE MARKS
190 IF A1$ = A2$ THEN 210
200 GOTO 280
210 PRINT#P,A2$," DISK ADDRESS ",\I#P,(Y(1)+256*Y(2))
PRESS RETURN TO CONTINUE
220 PRINT#P,"IT IS ",(2*(256*Y(4)+Y(3))),"BLOCKS LONG "
230 IF Y(5)<128 THEN !#P,"SINGLE DENSITY " ELSE Y(5)=Y(5)-128
240 PRINT#P,"ITS FILE TYPE IS ",Y(5)
250 IF Y(5)=1 THEN !#P,"GO ADDRESS IS ",(256*Y(7)+Y(6))
260 !#P,"TYPE DEPENDENT INFORMATION IS ",Y(6),Y(7),Y(8)
270 GOTO 300
280 NEXT J
290 PRINT#P,"FILE NOT ON THIS DISK "
300 CLOSE#1\GOTO 10
READY
```

Quest program listing.

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EXAMPLES FROM MTU-BASIC

ENTER "TRANSFER3"
Reads in an ASCII text file as program statements.

SYSTEM "ASSIGN 1 BASICIN"
Redirects input from keyboard to disk file named BASICIN.

LEGEND 1, "First," "Second"
Relegends function keys 1 and 2 to read "First" and "Second".

LTPEN F, X, Y
Sets F = 1 and X, Y to coordinates when lightpen picks a point.

GRIN NW$, X, Y
Displays crosshair and inputs X, Y location of its final position; NW$ contains the exit key.

DRAW .0645, 3*Y
Draw a vector from current location of graphic cursor to specified coordinates.

LIB "VGL," "IGL"
Select library extensions to be linked to BASIC.

The base MTU-130-1S system comes with one single-sided double-density 8″ floppy disk, a 12″ green phosphor CRT, and MTU-BASIC for $3995. Three other models priced up to $4995 contain 1 or 2 single or double sided drives for up to 2 Megabytes of storage. 4 Megabyte systems available on request.

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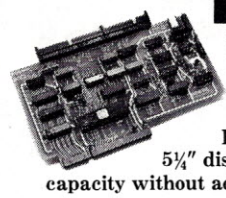

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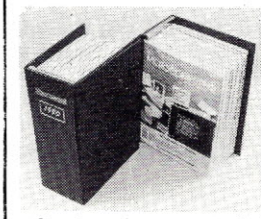

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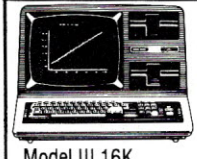

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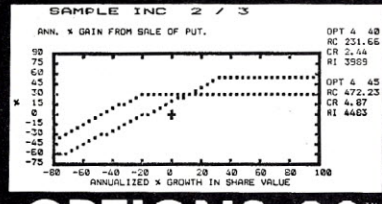

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Here are a couple of tips that take the aggravation out of computing.

Little Bits

Bag It

By Kenneth Reid

Many computer hobbyists and professionals have been made painfully aware of the disastrous effects of spilled liquids—coffee and soft drinks, in particular—on computer keyboards. Once the gunk gets in around the keys it is nearly impossible to remove, and the sticky keys are a continual aggravation.

The best remedy is prevention. A thin sheet of transparent plastic, secured over the keyboard, will ward off spills without affecting keyboard operation. If your keyboard is separated from your video screen, as mine is, you can simply place the entire keyboard in a large clear plastic bag. If you have an all-in-one system, a sheet of Saran Wrap or similar clear plastic material will provide nearly the same level of protection if well secured with masking tape.

So before you eat, drink or make merry at your keyboard, bag it! The temper you save will be your own. ■

Kenneth Reid, 1935 Trevilian Way, Louisville, KY 40205.

Hex Table

By F. LaPointe

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10
2	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11
3	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12
4	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13
5	6	7	8	9	A	B	C	D	E	F	10	11	12	13	14
6	7	8	9	A	B	C	D	E	F	10	11	12	13	14	15
7	8	9	A	B	C	D	E	F	10	11	12	13	14	15	16
8	9	A	B	C	D	E	F	10	11	12	13	14	15	16	17
9	A	B	C	D	E	F	10	11	12	13	14	15	16	17	18
A	B	C	D	E	F	10	11	12	13	14	15	16	17	18	19
B	C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A
C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B
D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C
E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D
F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E

Hex addition/subtraction table.

Remember those math tables from grade school? Here's a little hex table to keep handy when you're writing that relative addressing instruction in assembly language.

F. LaPointe, 33 Windsor Court, Lansdale, PA 19446.

Are you suffering from bad memory?
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Putting PET To the Test

By Garold R. Stone

Here is an adaptation for the PET computer of Fred Monsour's rigorous machine-language RAM test program ("Cook's Memory Test for the 6502," *Microcomputing*, June 1980, p. 178). It can be loaded and run on new ROM (3.0) and old ROM (2.0) PETs, with or without the machine-language monitor.

The Test

The program (Listing 1) repeatedly tests a specified range of RAM, printing an asterisk (*) as it completes each pass. If a bad byte is found, an error code (A,B,C, or D) will be printed, followed by the faulty address in hexadecimal. It takes about three seconds to test each eight kilobytes of RAM.

According to Monsour's article, error code "A indicates a byte that can't have all 0's stored in it. Error B usually is due to shorted or open address lines, while error C is due to shorted or open data lines. Error D signifies a byte that can't store all 1's."

For example, if an error C is found, the location of the bad bit (1-8) is printed first, followed by the error code and the hexadecimal address 4C1000.

From KIM to PET

Monsour's KIM program is self-contained, except for the use of one KIM ROM routine, OUTCHR, to output the results of the test. I substituted a PET ROM routine, WRT, which prints the contents of the 6502 accumulator as a character on the screen. It also updates the cursor position to be ready for the next character. No 6502 registers are changed by WRT.

Relocating the program to PET's second cassette buffer area was straightforward. None of the branch instructions had to be changed—just the jump and jump subroutine instructions. I changed the variables to locations which would not conflict with the operation of the BASIC interpreter in either the old or new ROM. I put the test in the second cassette buffer so that all of the PET's absolute RAM (0400 hex up) could be tested in one pass.

Unlike the KIM, the PET has no key that will trigger a hardware interrupt to stop a machine-language program, so I added a software interrupt routine. Where Monsour's program calls subroutine INC to increment the pointer, POINTL,H, to the next byte to be tested, I substituted a call to my subroutine, STOP (03ED hex), which tests for any depressed key (except shift). If no key is down, the PET ROM routine GET returns with the zero status flag set.

The branch if equal (BEQ) test is satisfied and the program branches to the instruction JUMP INC. INC increments the test pointer, POINTL,H, and returns to the address just below where STOP was called. If a key is down, the branch test fails and the software break instruction (BRK) is executed.

BRK loads the 6502 program counter with the address specified in the

Set BRK interrupt vector for BASIC:

Old ROM	New ROM	
POKE 539,137	POKE146,137	(low byte)
POKE 540,195	POKE 147,195	(high byte)

Set test range from BASIC:

POKE 60, SL	(STARTL)
POKE 61, SH	(STARTH)
POKE 62, EL	(ENDL)
POKE 63, EH	(ENDH)

(See Table 2 for decimal values.)

Run test: SYS 826

Table 1. Running under BASIC.

Memory size in hex	SL	SH	EL	EH
8K (0400–2000)	0	4	0	32
16K (0400–4000)	0	4	0	64
24K (0400–6000)	0	4	0	96
32K (0400–8000)	0	4	0	128
32K plus video (0400–8400)	0	4	0	132
Video only (8000–8400)	0	128	0	132

Table 2. Test range values in decimal.

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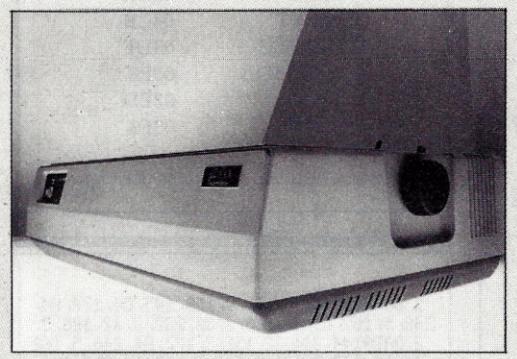

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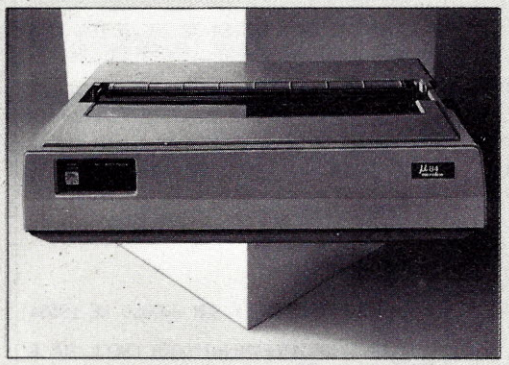
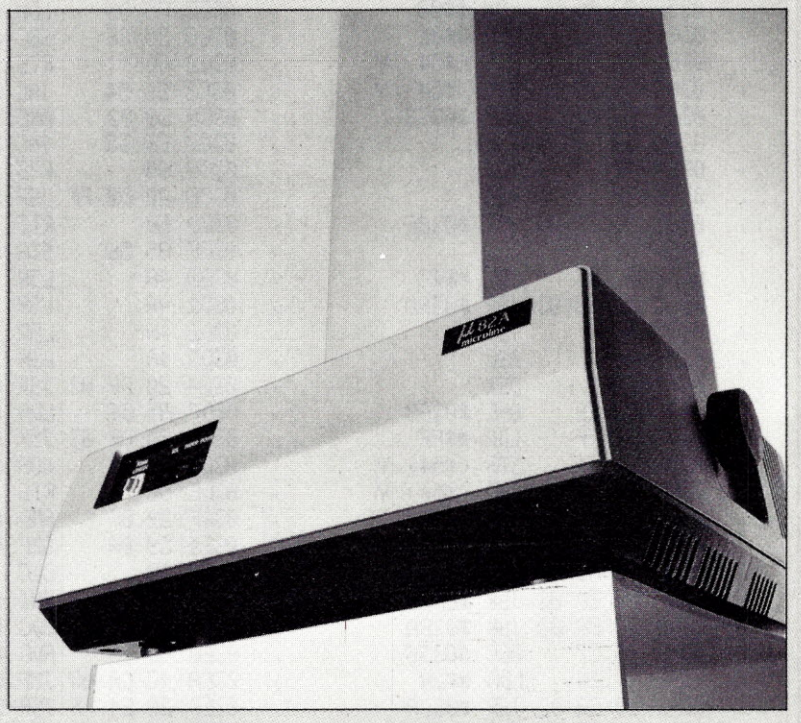


ML-84: Correspondence quality and data processing throughput. Prints bi-directionally at up to 200 cps, including charts, illustrations, forms, or dot-addressable graphics.



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contents of the break interrupt vector. In new ROM PETs the break interrupt vector (0092,0093 hex) is set at power on (or reset) to contain the address of the warm start entry point for the machine-language monitor in ROM (FD17 hex). Commodore calls this monitor TIM for terminal interface monitor. In old ROM PETs the break interrupt vector is set to TIM's warm start address when TIM is loaded and run from tape. Users of old ROM may wish to use the program in Listing 2 to load the test, but they will have to set the break interrupt vector to the warm start point for BASIC, so that the test will return to BASIC when a key is pressed. Table 1 shows how to set up and run the test from BASIC, for old and new ROMs.

Running under TIM

Enter TIM and set the range of RAM to be tested in the variables START and END. Put the low-order byte of the starting address (in hex) into STARTL and the high-order byte in STARTH. The variable END should be set to one byte higher than the last byte to be tested. ENDL is the low-order byte and ENDH is the high-order byte. Execute the program from the monitor with G 033A. Pressing any key during the test will cause a break back to the machine-language monitor.

General Considerations

Remember that the first kilobyte of RAM (0000-03FF hex) cannot be tested because it holds the pointers for the PET operating system. Testing this area would cause the PET to go out of control. To test the two RAM

```
. ,  033A 20 97 03 JSR $0397
. ,  033D A9 00    LDA #$00
. ,  033F A8       TAY
. ,  0340 91 54    STA ($54),Y
. ,  0342 B1 54    LDA ($54),Y
. ,  0344 F0 05    BEQ $034B
. ,  0346 A2 41    LDX #$41
. ,  0348 20 A0 03 JSR $03A0
. ,  034B 20 ED 03 JSR $03ED
. ,  034E 20 BA 03 JSR $03BA
. ,  0351 90 EA    BCC $033D
. ,  0353 20 97 03 JSR $0397
. ,  0356 B1 54    LDA ($54),Y
. ,  0358 F0 05    BEQ $035F
. ,  035A A2 42    LDX #$42
. ,  035C 20 A0 03 JSR $03A0
. ,  035F A2 08    LDX #$08
. ,  0361 A9 01    LDA #$01
. ,  0363 91 54    STA ($54),Y
. ,  0365 D1 54    CMP ($54),Y
,  0367 F0 00    BEQ $0376
,  0369 9A       TXS
,  036A 48       PHA
,  036B 8A       TXA
,  036C 20 CE 03 JSR $03CE
,  036F 68       PLA
,  0370 A2 43    LDX #$43
,  0372 20 A0 03 JSR $03A0
,  0375 BA       TSX
,  0376 0A       ASL
,  0377 CA       DEX
,  0378 D0 E9    BNE $0363
,  037A A9 FF    LDA #$FF
,  037C 91 54    STA ($54),Y
,  037E D1 54    CMP ($54),Y
,  0380 F0 05    BEQ $0387
,  0382 A2 44    LDX #$44
,  0384 20 A0 03 JSR $03A0
,  0387 20 ED 03 JSR $03ED
,  038A 20 BA 03 JSR $03BA
,  038D 90 C7    BCC $0356
,  038F A9 2A    LDA #$2A
,  0391 20 CA 03 JSR $03CA
,  0394 4C 3A 03 JMP $033A
,  0397 A5 3C    LDA $3C
,  0399 85 54    STA $54
,  039B A5 3D    LDA $3D
,  039D 85 55    STA $55
,  039F 60       RTS
,  03A0 48       PHA
,  03A1 98       TYA
,  03A2 48       PHA
,  03A3 8A       TXA
,  03A4 20 CA 03 JSR $03CA
,  03A7 A5 55    LDA $55
,  03A9 20 CE 03 JSR $03CE
,  03AC A5 54    LDA $54
,  03AE 20 CE 03 JSR $03CE
,  03B1 A9 20    LDA #$20
,  03B3 20 CA 03 JSR $03CA
,  03B6 68       PLA
,  03B7 A8       TAY
,  03B8 68       PLA
,  03B9 60       RTS
,  03BA A5 54    LDA $54
,  03BC C5 3E    CMP $3E
,  03BE A5 55    LDA $55
,  03C0 E5 3F    SBC $3F
,  03C2 60       RTS
,  03C3 E6 54    INC $54
,  03C5 D0 02    BNE $03C9
,  03C7 E6 55    INC $55
,  03C9 60       RTS
,  03CA 20 D2 FF JSR $FFD2
,  03CD 60       RTS
. ,  03CE 85 56    STA $56
. ,  03D0 4A       LSR
. ,  03D1 4A       LSR
. ,  03D2 4A       LSR
. ,  03D3 4A       LSR
. ,  03D4 20 DF 03 JSR $03DF
. ,  03D7 A5 56    LDA $56
. ,  03D9 20 DF 03 JSR $03DF
. ,  03DC A5 56    LDA $56
. ,  03DE 60       RTS
. ,  03DF 29 0F    AND #$0F
. ,  03E1 C9 0A    CMP #$0A
. ,  03E3 18       CLC
. ,  03E4 30 02    BMI $03E8
. ,  03E6 69 07    ADC #$07
. ,  03E8 69 30    ADC #$30
. ,  03EA 4C CA 03 JMP $03CA
. ,  03ED 20 E4 FF JSR $FFE4
. ,  03F0 F0 01    BEQ $03F3
. ,  03F2 00       BRK
. ,  03F3 4C C3 03 JMP $03C3
. ,  03F6 00       BRK
. ,  03F7 00       BRK
. ,  03F8 00       BRK
. ,  03F9 00       BRK
. ?
```

Listing 1. Test program (see Table 1).

BEGINA	033A
NEXTA	033D
INCA	034B
BEGINB	0356
WALK	035F
NEXTB	0363
SHIFT	0376
INCB	0387
INIT	0397
ERR	03A0
COMP	03BA
INC	03C3
RET	03C9
PRNT	03CA
PRBYT	03CE
HEXASC	03DF
HEXASD	03E8
STOP	03ED
GOINC	03F3

Table 3. Statement labels for Listing 1.

```
 1 DATA32,151,3,169,0,168,145,84,177,84,
240,5,162,65,32,160,3,32,237,3,32,186,3
 2 DATA144,234,32,151,3,177,84,240,5,162
,66,32,160,3,162,8,169,1,145,84,209,84
 3 DATA240,13,154,72,138,32,206,3,104,16
2,67,32,160,3,186,10,202,208,233,169,255

 4 DATA145,84,209,84,240,5,162,68,32,160
,3,32,237,3,32,186,3,144,199,169,42,32
 5 DATA202,3,76,58,3,165,60,133,84,165,6
1,133,85,96,72,152,72,138,32,202,3,165,8
5
 6 DATA32,206,3,165,84,32,206,3,169,32,3
2,202,3,104,168,104,96,165,84,197,62,165

 7 DATA85,229,63,96,230,84,208,2,230,85,
96,32,210,255,96,133,86,74,74,74,74,32,2
23
 8 DATA3,165,86,32,223,3,165,86,96,41,15
,201,10,24,48,2,105,7,105,48,76,202,3,32

 9 DATA228,255,240,1,0,76,195,3
 10 Y=0
 20 FORI=826TO1013
 30 READX:POKEI,X
 40 Y=Y+X:NEXT
 45 PRINT"DATA CHECK SUM SHOULD BE 19554
":PRINT
 50 IFY<>19554THENPRINT"DATA CHECK SUM E
RROR:"Y:END
 60 PRINT"DATA CHECK SUM OK:"Y:END
READY.
```

Listing 2. Poker/Loader.

chips that store these pointers, swap them with chips at a higher address. When testing the video range, the screen will fill with at signs (@) and the checkerboard character (code 255), thus obscuring the asterisk until an error code is printed.

Old ROM users should note that testing RAM from 0400-076A hex will overwrite the machine-language monitor. The test itself will run, but if a key is pressed to stop the test, the PET will break to the now nonexistent monitor and it will crash.

Those with the Programmer's Tool Kit or disk units or any other programs which use the second cassette buffer will want to make sure they are not running. Otherwise they may overwrite the test program. For the same reason, some users may not be able to copy the test program intact to disk.■

References

"It's Here: Cook's Memory Test" (8080 version), Rod Hallen, *Microcomputing,* July 1978, p. 70.

"Memory Trouble Shooting Techniques," Charles Cook, *Microcomputing,* Oct. 1977, p. 58.

Pet Machine Language Guide, Abacus Software, Grand Rapids, MI, 1979, routines WRT, GET.

PET/CBM Personal Computer Guide, Donahue and Enger, Osborne/McGraw-Hill, Berkely, CA, 1980, Memory maps—NEW, p. 334; OLD, p. 414.

PET/CBM User's Manual (NEW ROM), routines WRT, GET & TIM, BRK, p. 116.

PET User's Manual, PET 2001-8 (OLD ROM), Oct. 1978, TIM, BRK, WRT, GET, pp. 97-111.


```
.
. :  033A 20 97 03 A9 00 A8 91 54
. :  0342 B1 54 F0 05 A2 41 20 A0
. :  034A 03 20 ED 03 20 BA 03 90
. :  0352 EA 20 97 03 B1 54 F0 05
. :  035A A2 42 20 A0 03 A2 08 A9
. :  0362 01 91 54 D1 54 F0 0D 9A
. :  036A 48 8A 20 CE 03 68 A2 43
. :  0372 20 A0 03 BA 0A CA D0 E9
. :  037A A9 FF 91 54 D1 54 F0 05
. :  0382 A2 44 20 A0 03 20 ED 03
. :  038A 20 BA 03 90 C7 A9 2A 20
. :  0392 CA 03 4C 3A 03 A5 3C 85
. :  039A 54 A5 3D 85 55 60 48 98
. :  03A2 48 8A 20 CA 03 A5 55 20
. :  03AA CE 03 A5 54 20 CE 03 A9
. :  03B2 20 20 CA 03 68 A8 68 60
. :  03BA A5 54 C5 3E A5 55 E5 3F
. :  03C2 60 E6 54 D0 02 E6 55 60
. :  03CA 20 D2 FF 60 85 56 4A 4A
. :  03D2 4A 4A 20 DF 03 A5 56 20
. :  03DA DF 03 A5 56 60 29 0F C9
. :  03E2 0A 18 30 02 69 07 69 30
. :  03EA 4C CA 03 20 E4 FF F0 01
. :  03F2 00 4C C3 03 00 00 00 00
. ?
```

Table 4. Hex dump.

Variable	Hex	Decimal	Function in New ROM
STARTL	003C	60	Current DATA line number (low-order byte)
STARTH	003D	61	Current DATA line number (high-order byte)
ENDL	003E	62	Current DATA line pointer (low-order byte)
ENDH	003F	63	Current DATA line pointer (high-order byte)
POINTL	0054	84	Floating point accumulator #3
POINTH	0055	85	Floating point accumulator #3
TEMP	0056	86	Floating point accumulator #3

Table 5. All variables are within the old ROM BASIC input buffer.

Routine	New ROM	Old ROM	Function in both ROMs
WRT	FFD2	FFD2	Write a character to the screen
GET	FFE4	FFE4	Get a character from keyboard; set status
READY	C389	C389	BASIC warm start
TIM	FD17	0427	Warm entry point for TIM
BRK	0092	021B	BRK interrupt vector location (low byte)
	0093	021C	BRK interrupt vector location (high byte)

Table 6. External routines.

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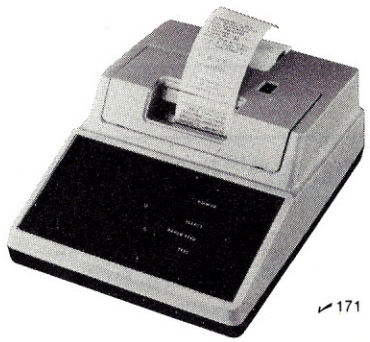

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Heath's Hidden Time-Saver

By Charles E. Cohn

Many applications require that the current date be shown on the printout. The program can, of course, have you enter the date. But if the operating system has already called for the date to be entered, it is much more convenient to extract the information internally, and save you the bother of entering the date a second time.

If you use a Heath H8 or H-89 with Benton Harbor BASIC and HDOS, it is easy to extract that information. HDOS stores the date in two different forms. First, and most straightforward, the nine bytes starting at location 8383 contain the date in alphanumeric in the form in which it was entered; e.g., 30-Oct-80. Even though the month may have been entered either in upper- or lowercase, the first letter of the month as stored is always capitalized, and the remaining two letters are stored as lowercase.

This information can be extracted as shown in Listing 1, which prints out the date just as stored. Variations are possible; you can, for example, drop off the hyphens or change the order of the month and the day.

```
00010 D$ = " "
00020 FOR I = 1 TO 9:D$ = D$ + CHR$(PEEK(8382 + I)):NEXT I
00030 PRINT D$
00040 END
```

Listing 1.

If you wish to do something fancier, such as print the full name of the month, you might want to use the date in the other form in which it is stored, i.e., in binary at locations 8392 and 8393. The low-order five bits of the byte at 8392 give the day, while the high-order three bits are the low-order part of the four-bit month. The low-order bit of the byte at 8393 is the high-order part of the month, while the remaining bits of that byte give the year minus 1970. This information can be used as shown in Listing 2, which prints the date in the form October 30, 1980. ■

```
00010 N1 = PEEK(8392):N2 = PEEK(8393):N3 = INT(N1/32):N4 = INT(N2/2)
00020 D = N1 - N3*32
00030 M = N3 + N2*8 - N4*16
00040 Y = N4 + 1970
00050 FOR I = 1 TO M:READ M$:NEXT I
00060 DATA January,February,March,April,May,June,July
00070 DATA August,September,October,November,December
00080 D$ = STR$(D)
00090 PRINT M$ + LEFT$(D$,LEN(D$) - 1) + ",";Y
00100 END
```

Listing 2.

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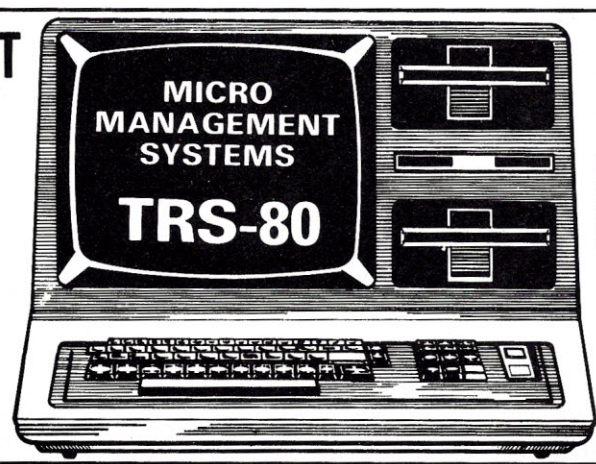

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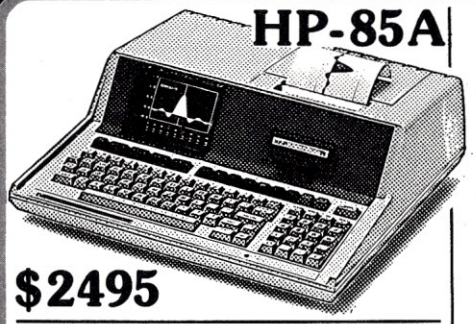

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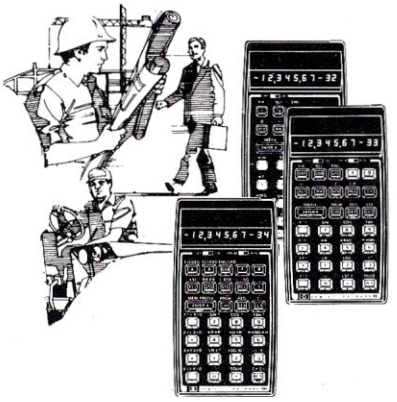

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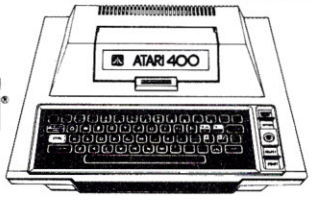

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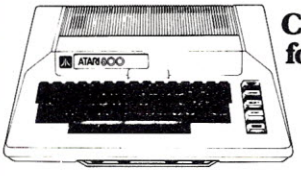

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By Brian McCorkle

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You need a self-latching monitor in ROM, and the ROM must be entered with register zero as the program counter.

The jump circuit cycles the 1802 through reset and into run. It also temporarily disables RAM at address #0000 and places the monitor at that address. The first memory write pulse resets the circuit and the system returns to normal operation.

IC1 is the 1802 (Fig. 1). Pin 2(wait) is tied to the 5-V supply. Pin 3(clear) is then used to set IC1 in the reset or run mode.

IC2, R1, R2, R3 and C1 is the reset run portion of the circuit. When you turn on the power the output of IC2 remains low for about 60 ms, holding IC1 in reset. IC2 then goes high, placing IC1 in the run mode. S1 is used to start this sequence from a running program. D1 provides for rapid discharge of C1 if power is lost.

The output of IC2 is also sent to IC3, which disables the RAM at #0000 and transfers the monitor to this location. IC3 is a 555 timer in the monostable mode, and its period is fairly long; but in practice it is reset by the first memory write pulse.

The output of IC3 is a high level which drives an OR circuit, consisting of D1, D2, and R5, high. This signal is also used to switch IC4, so a low level is placed on the chip enable of the monitor ROM.

S2 is a run at zero switch. S2A does the same thing as S1. S2B times IC3 out before the reset period is done so no memory switching takes place.

As mentioned, the monitor must be self-latching. Listing 1 gives a way to go about this. The Quest monitor V1.1 does work, and the VIP monitor should also work.

The layout of this project is not critical. The prototype was wire-wrapped and distributed over several boards.

In case you have trouble, first check for shorts and opens. Then be sure all COME-FROMs and GOTOs match.

If this doesn't correct the problem, temporarily place a 10 μF capacitor in parallel with C1. The output of IC2 should stay low for about one-half second after power on or S1 depression. The output should then go high. The output of IC3 should go high during this period and drop low shortly thereafter. If this output remains high for ten seconds, then IC3 is not being reset by a memory write pulse. Finally, the cathode of D1 should be a high level and pins 3 and 11 of IC4 should be a low level.

This simple circuit will eliminate a great deal of key punching. I have found it a great convenience well worth building into a system. ■

Parts List

C1	1 μF tantalum
C2	.01 μF ceramic
C3	10 μF tantalum
D1,2,3	1N914
IC1	1802
IC2	4050 hex buffer
IC3	555 timer
IC4	4066 quad switch
R1,5	47k ohm
R2,6	22k ohm
R3	100k ohm
R4	1 megohm
all resistors ¼ watt 5 percent	
S1	1 pole, normally open momentary contact
S2	2 pole, normally open momentary contact

Fig. 1. The hardware required for a power-on jump to monitor.

```
At start Register 0 is at 0000.
4000 F840     LDI #40          40 is example. This number is determined by ROM
                               location.
4002 B0       PHI RO           Register 0 now at 4003.
4003 F82FB2   LDI #2F,PHI R2
4006 F8FFA2   LDI #FF,PLO R2
4009 E2       SEX R2           Locate data pointer to free location.
400A 73       STXD             Memory write to reset timer.
etc.
```

Listing 1. Example of the requirement of the ROM to latch its own address and reset the timer with a memory write pulse. The addresses given are examples. Actual values will depend on where your ROM is located.

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MICRO QUIZ

(from page 22)

Answer: 67

This program finds the index of the rightmost occurrence of the string LS within the string S8.

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CALENDAR

Texas Computer Show

The Texas Computer Show will be held Jan. 20–22 in Dallas. Contact the Texas Computer Show, PO Box 214035, Dallas, TX.

Virginia Tech Chemathon Workshops

The first Tech Chemathon Workshops will be held in Feb. and March at Virginia Polytechic Institute and State University in Blacksburg, VA. Three of the lecture/laboratory workshops will focus on microcomputers: Digital Electronics for Instrumentation, Feb. 25–27; Microcomputing Interfacing Design and Programming, March 1–3; and Personal Computers for Instrument Automation, March 4–6.

For more information contact Dr. Linda Leffel, CEC., VPI and SU, Blacksburg, VA 24061. 703-961-4848.

Robots VI Conference and Exposition

The Robots VI Conference and Exposition will be held March 1–4 in Detroit, MI. Contact RI/SME, One SME Drive, PO Box 930, Dearborn, MI 48128. 313-271-1500, ext. 416.

Microcomputer Week '82

Microcomputer Week, a five-day conference on microcomputers in education, will be held March 3–7 at Jersey City State College, Jersey City, NJ.

Courses will be offered in more than 20 subjects. Participants may earn graduate level credit.

For more information write Catalyst Conference, H 112, Jersey City State College, 2039 Kennedy Blvd., Jersey City, NJ 07305.

Human Factors in Computer Systems Conference

The Human Factors in Computer Systems Conference will be held March 15–17 in Gaithersburg, MD. Contact Michael L. Schneider, Sperry-Univac, PO Box 200, Blue Bell, PA 19424. 215-542-5808.

Software/Expo-West

Software/Expo-West, a conference and show about packaged software, will be held March 16–18, at the Anaheim Convention Center, Anaheim, CA.

For more information write Software/Expo-West, Suite 400, 222 West Adams St., Chicago, IL 60606. 312-263-3131.

Seventh West Coast Computer Faire

The seventh West Coast Computer Faire will be held March 19–21 in San Francisco, CA. Contact Laurie McLean, 333 Swett Road, Woodside, CA 94062. 415-851-7075.

Videotext '82

Videotext '82 will be held April 12–16 in New York City. Contact Steve Weissman, Information Gatekeepers, Inc., 167 Corey Road, Brookline, MA 02146. 617-739-2022.

Symposium on Security and Privacy

The 1982 Symposium on Security and Privacy, sponsored by the IEEE Computer Society, will take place on April 26–28, 1982, at the Claremont Hotel in Oakland/Berkeley, CA.

Papers and proposals for panel sessions related to security and privacy are being solicited. Possible topics include encryption, database security, operating system and privacy protection.

Submit for review by Feb. 1, 1982, six copies of your paper or panel proposal to Dr. Peter Neumann, SRI International EL301, 333 Ravenswood Ave., Menlo Park, CA 94025.

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Technical papers outlining insights or advances in computer peripheral equipment or software packages are being sought for presentation at the first International Computer Peripheral Equipment and Software Exposition.

The conference/exhibition will be held Sept. 29 through Oct. 1, 1982, at the Anaheim Convention Center, Anaheim, CA.

Deadline for abstracts is March 26, 1982. Abstracts, including author's name, title, company, address, phone and telex, should be submitted as soon as possible to William D. Ashman, Program Coordinator—Peripheral '82, Cahners Exposition Group, 222 W. Adams St., Chicago, IL 60606.

Automotive Applications of Microprocessors

A workshop on the automotive applications of microprocessors sponsored by the Industrial Electronics Society of IEEE will be held Oct. 7 and 8, 1982, at the Hyatt Regency Hotel, Dearborn, MI.

The workshop will focus on applications of microprocessors to automobiles, trucks, vans and allied automotive products.

Papers are being solicited for presentations at the workshop. Those interested in presenting a paper at the workshop should submit two copies of a 300–500 word summary (double-spaced) to John G. Neuman, Technical Program Chairman, General Motors Research Labs, Electrical Engineering Dept., GM Technical Center, Warren, MI 48090, by Feb. 15.

The Sixth Western Educational Computing Conference

The sixth Western Educational Computing Conference will be held in San Diego, CA, on Nov. 18 and 19, 1982, under the sponsorship of the California Educational Computing Consortium.

Original papers dealing with computers and computer applications in any area that might be of intrest to instructors and administrators who use computers at the college or university level should be sent no later than March 1, 1982, to Professor Grant, Center for Information and Communications Study, California State University, Chico, CA 95929. They should be typed, double-spaced and approximately 1500 words in length. The title page of each paper must contain the author's name, complete mailing address and telephone number. A brief abstract should precede the text.

Contributors will be notified of the acceptance of their papers by May 1, 1982.

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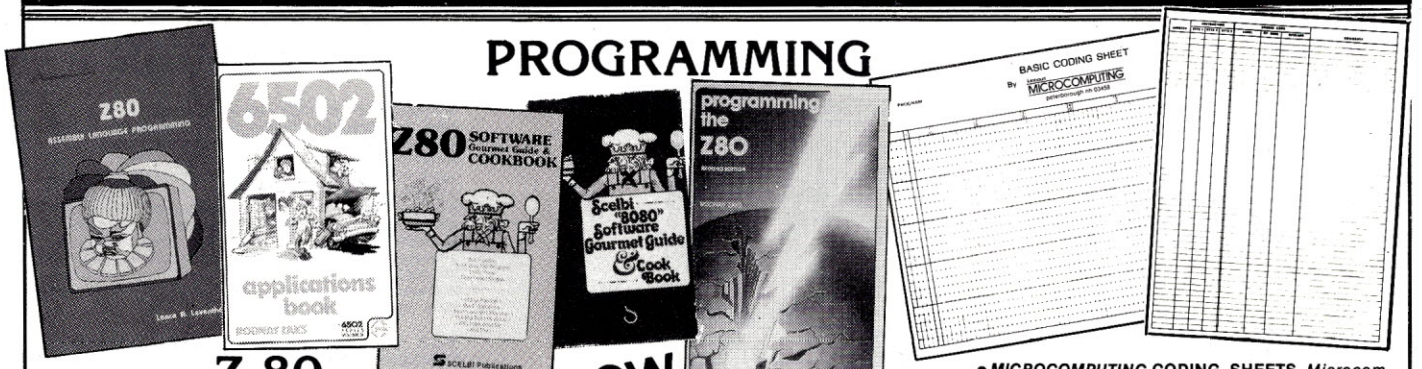

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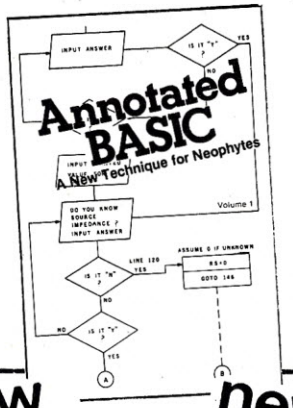

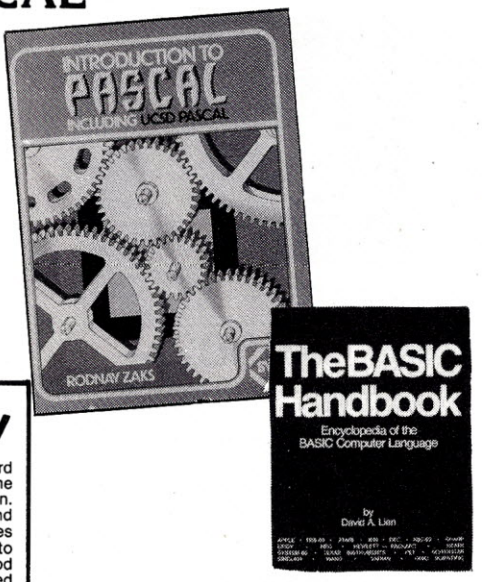

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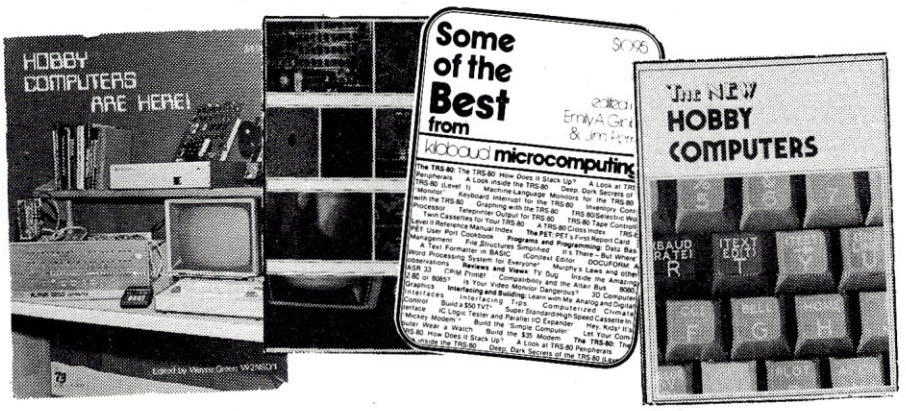

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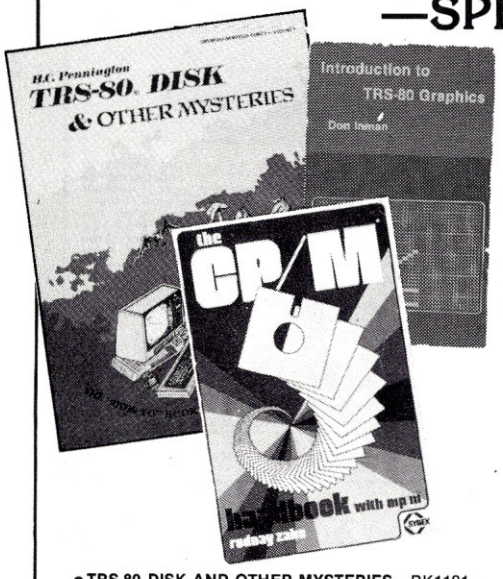

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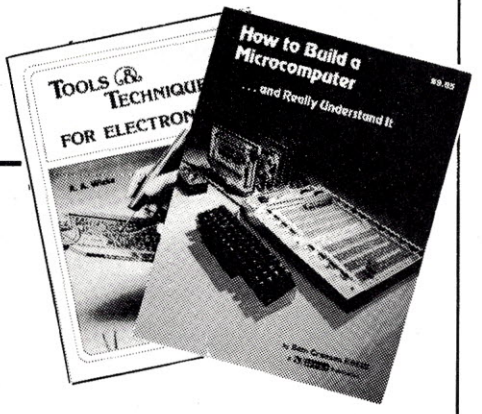

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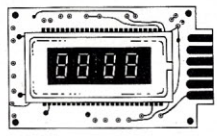

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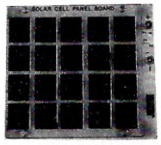

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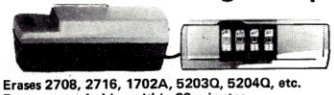

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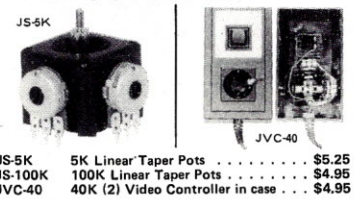

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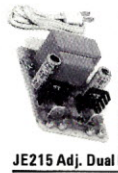

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82S25	64 Bit RAM (16x4OC)	3.49
UPD414/MK4027	4K Dynamic 16-pin	4.95
TMS4044-45NL	4K Static	9.95
TMS4045	1024x4 Static	9.95

PROMS/EPROMS

1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	4.95
TMS2716	16K EPROM (-5V, +5V, +12V)	9.95
2716Intel(2516)TI	16K EPROM (Single +5V)	8.95
2732Intel TI	32K EPROM	17.95
2758	8K EPROM (450ns) (Single +5V)	7.49
2764Q	64K EPROM (Hitachi HN462764)	49.95
5203	2048 PROM	14.95
82S23(74S188)	32x8 PROM (Open Collector)	3.95
82S115	4096 Bipolar PROM	14.95
82S123(74S288)	32x8 Tri-State Bipolar PROM	3.95
82S185	8K PROM	16.95

— Over 30 More PROMS Listed in Our Catalog —

ROM'S

2513(2140)	Character Generator (Upper Case)	9.95
2513(3021)	Character Generator (Lower Case)	9.95

NMOS READ ONLY MEMORIES

MCM66710P	128x9x7 ASCII Shifted w/Greek	13.50
MCM66740P	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	128x9x7 Alpha. Control Char. Gen.	13.50

MICROPROCESSOR MANUALS

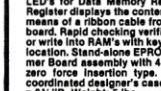
M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

SPECIAL FUNCTION

DS0025CN	Dual MOS Clock Driver (5MZ)	3.50
DS0026CN	Dual MOS Clock Driver (5MZ)	1.95
INS1771N-1	Floppy Disc Controller	24.95
INS2651N	Communication Chip	19.95
MM5163/7N	Microprocessor Real Time Clock	8.95
MM58174N	Microprocessor Compatible Clock	11.95
COP402N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.95
COP402MN	Microcontroller with 64-Digit RAM & Direct LED Drive w/N Buss Int.	7.49
COP470N	32-Seg. VAC Fluor. Driver (20-pin pkg.)	3.25

TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialer	14.95
AY-5-9200	Repertory Dialer	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (66 keys)	11.95
HD0165-5	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.49
74C923	Keyboard Encoder (20 keys)	5.75
MM53190N	Push Button Pulse Dialer	7.95
MM57499N	96/144-Key Serial Keyboard Encoder	8.95



2400-10

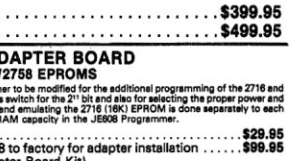
EECO Rocker DIP Switch — "Mini-Dip™" 2400 Series

THE MOST UNIQUE DIP SWITCH AVAILABLE!

MINI-DIP is designed to retrofit all major brands of Dip switches. Unique features include locking rod design to prevent accidental actuation and gold self-wiping contact. One-piece housing and press-fit terminals prevent contamination. 2-10 station Form "A" and 1-5 station Form "C."
- Terminals on .100 x .300 (2.54 x 7.62) centers • PCB or dip socket mountable • Positive cleaning/wiping action with gold contact • Total seal and bottom seal

Part No.	Pos.	Configuration	Socket	Price
2400-2	2	12	8 pin	.79 - 10/ 6.95
2400-3	3	123	8 pin	.89 - 10/ 7.95
2400-4	4	1234	8 pin	.99 - 10/ 8.95
2400-ABCD	4	ABCD	8 pin	.99 - 10/ 8.95
2400-5C	6	C54321	14 pin	1.09 - 10/ 9.95
2400-6	6	123456	14 pin	1.09 - 10/ 9.95
2400-7	7	1234567	14 pin	1.19 - 10/10.95
2400-8	8	12345678	16 pin	1.29 - 10/11.95
2400-9	9	123456789	18 pin	1.39 - 10/12.95
2400-10	10	0123456789	20 pin	1.49 - 10/13.95

JE608 PROGRAMMER
2704/2708 EPROM PROGRAMMER



GENERAL APPLICATIONS:
- To program EPROMS 2704 and 2708.
- Developmental system for microcomputer circuits
- To read the contents of a pre-programmed EPROM
- To compare EPROM(s) for content differences
- To emulate a programmed EPROM
- To store program in RAMS for alterations
- Three separate Display Registers: 8 LED's for Hex Key entries, 10 LED's (2^20) for Address Register and 8 LED's for Data Memory Register. The Data Memory Register displays the content of the RAMs from the EPROM Chip. Development of microprocessor systems by means of a ribbon cable from the programmer panel test socket to the EPROM socket on the microprocessor board. Rapid checking verification of programmed data changes. User may move data from a master to RAM's or write into RAM's with keyboard entries. Allows manual stepping manipulation (up and down) at any address location. Stand-alone EPROM Programmer consisting of: A 19-key Hexadecimal Keyboard assembly, Programmer Board assembly with 4 power supplies and a LED/Test Socket Panel Board assembly. The Test Socket is a zero force insertion type. Power requirements: 115VAC, 60Hz, 6W. Compact desk-top enclosure: Color-coordinated designer's case with light tan panels and molded end pieces in mocha brown. Size: 3¼"H x 11"W x 8¼"D. Weight: 5 lbs.

The JE608 EPROM Programmer is a completely self-contained unit which is independent of computer control and requires no additional systems for its operations. The EPROM can be programmed from the Hexadecimal Keyboard or from a pre-programmed EPROM. The JE608 Programmer can emulate a programmed EPROM by the use of its internal RAM circuits. This will allow the user to test or pretest a program for a system, prior to programming a chip. Any changes in the program can be entered directly into the memory circuits with the Hexadecimal Keyboard so that rewriting the entire program will not be necessary. The JE608 Programmer contains a Programmer Board w/25 IC's & includes power supplies of: -5V, +5V, +12V and +25V. The Hexadecimal Keyboard and LED/Test Socket Panel board are separate assemblies within the system.

JE608K Kit $399.95
JE608A Assembled and Tested $499.95

JE608-16K ADAPTER BOARD
FOR 2716/2758 EPROMS

GENERAL DESCRIPTION:
The JE608-16K Adapter Board allows the JE608 Programmer to be modified for the additional programming of the 2716 and 2758 EPROMS. The adapter provides for adding an address switch for the 2^11 bit and also for selecting the proper power and timing pulses to be applied to the EPROM. Programming and emulating the 2716 (16K) EPROM is done separately to each half (1024x8) of the EPROM because of the existing 8K RAM capacity in the JE608 Programmer.

JE608-16K	Adapter Board Kit $29.95
JE608-Upgrade	(Send assembled JE608 to factory for adapter installation . . . . . $99.95 of the JE608-16K Adapter Board Kit)
JE608A-16K Mod.	Assembled JE608 w/Adapter (JE608-16K) Installed $599.95

$10.00 Min. Order — U.S. Funds Only
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BOOKS
National Semiconductor — Intersil — Intel

30001	National CMOS Data Book (640 pages) 74C, CD4000, and A/D Converters	$6.95
30002	National Interface Data Book (704 pages) DP, DS8900, DS3600, DS75000, etc.	$6.95
30003	National Linear Data Book (1376 pages) LM, LF, ADC, DAC, LH Series	$8.95
30004	National Series 80 — Board Level Computer (224 pages)	$4.95
30005	National TTL Logic Data Book (624 pages) 7400,LS,L,H,S, and DM8000 Series	$8.95
30006	Buy above (3) 30001,3,5 as a set	$19.95/lot
30009	Intersil Data Book (1074 pages)	$6.95
010400	Intel Component Data Catalog Full data sheets for Intel's products incl. memory devices, microproc., peripherals & indust./mil. products (1328 pages)	$10.00
206610	Intel Peripheral Design Handbook Full data sheets, appl. notes for Intel peripheral device components (644 pages)	$7.50

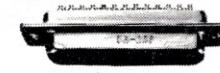
AC and DC Wall Transformers

With Universal Plug and 9V Battery Snap

Selective voltages: 6,9,12VDC. Polarity selection (+/-). six-foot line from adapter to plugs — six-inch line from adapter to battery snap. 120V/60Hz. 300mA.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12VAC 250mA	$3.95
AC 500	117V/60Hz	12VAC 500mA	$4.95
AC1000	117V/60Hz	12VAC 1 amp	$5.95
AC1700	117V/60Hz	9VAC 1.7 amp	$3.95
DC6912	120V/60Hz	6,9,12VDC 300mA	$9.95
DV9200	117V/60Hz	9VDC 200mA	$3.25
DC900	120V/60Hz	9VDC 500mA	$3.95

CONNECTORS



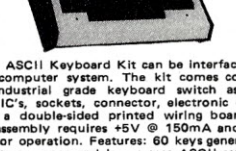
DB25P	D-Subminiature Plug	$2.95
DB25S	D-Subminiature Socket	$3.50
D20418-2	Screw Lock Hdwr. (2) DB25S/P	2/$.99
DB51226	Cover for DB25P/S	$1.75
22/44SE	P.C. Edge (22/44 Pin)	$2.95
UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adapter	$ .49
SO239	UHF Panel Recp.	$1.29
PL258	UHF Adapter	$1.60
PL259	UHF Plug	$1.60
UG260/U	BNC Plug	$1.79
UG1094/U	BNC Bulkhead Recp.	$1.29

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
- ★ 8 ea. MM5290 (UPD416/4116) 16K Dyn. Rams (*NS)
- ★ Documentation for Conversion

TRS-16K2 *150NS	$29.95
TRS-16K3 *200NS	$24.95
TRS-16K4 *250NS	$19.95

JE610 ASCII Encoded Keyboard Kit



The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and —12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3½"H x 14½"W x 8¾"D

JE610/DTE-AK (After assembled as pictured above) . . **$124.95**

JE610 Kit 62-Key Keyboard, PC Board, & Components (no case). . . . **$ 79.95**
K62 62-Key Keyboard (Keyboard only) . . . **$ 34.95**
DTE-AK (case only — 3¾"Hx11"Wx8¾"D) **$ 49.95**

NEW!

JE212 — Negative 12VDC Adapter Board Kit for JE610 ASCII KEYBOARD KIT
Provides -12VDC from incoming 5VDC . . **$9.95**

JE600 Hexadecimal Encoder Kit

FULL 8-BIT LATCHED OUTPUT 19-KEY KEYBOARD

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3½"H x 8¼"W x 8¾"D

JE600/DTE-HK (After assembled as pictured above) **$99.95**

JE600 Kit 19-Key Hexadec. Keyboard, PC Board & Cmpnts. (no case) . . **$59.95**
K19 19-Key Keyboard (Keyboard only) **$14.95**
DTE-HK (case only — 3½"Hx8¾"Wx8¾"D) **$44.95**

7400

SN7400N	.20	SN7472N	.29	SN74156N	.79
SN7401N	.20	SN7473N	.35	SN74157N	.69
SN7402N	.25	SN7474N	.35	SN74160N	.89
SN7403N	.25	SN7475N	.49	SN74161N	.89
SN7404N	.25	SN7476N	.35	SN74162N	.89
SN7405N	.29	SN7479N	5.00	SN74163N	.89
SN7406N	.35	SN7480N	.50	SN74164N	.89
SN7407N	.35	SN7482N	.99	SN74165N	.89
SN7408N	.29	SN7483N	.69	SN74166N	1.25
SN7409N	.29	SN7485N	.89	SN74167N	2.79
SN7410N	.25	SN7486N	.35	SN74170N	1.95
SN7411N	.29	SN7489N	1.75	SN74172N	4.95
SN7412N	.35	SN7490N	.49	SN74173N	1.39
SN7413N	.40	SN7491N	.59	SN74174N	.99
SN7414N	.69	SN7492N	.45	SN74175N	.89
SN7416N	.29	SN7493N	.45	SN74176N	.79
SN7417N	.29	SN7494N	.69	SN74177N	.79
SN7420N	.25	SN7495N	.69	SN74179N	1.49
SN7421N	.29	SN7496N	.69	SN74180N	.79
SN7422N	.45	SN7497N	3.00	SN74181N	2.25
SN7423N	.29	SN74100N	1.49	SN74182N	.79
SN7425N	.29	SN74104N	.89	SN74184N	2.49
SN7426N	.29	SN74105N	.89	SN74185N	2.49
SN7427N	.25	SN74107N	.35	SN74190N	1.25
SN7428N	.49	SN74109N	.39	SN74191N	1.25
SN7430N	.25	SN74116N	1.95	SN74192N	.89
SN7432N	.29	SN74121N	.39	SN74193N	.89
SN7437N	.25	SN74122N	.55	SN74194N	.89
SN7438N	.40	SN74123N	.59	SN74195N	.69
SN7439N	.25	SN74125N	.49	SN74196N	.89
SN7440N	.20	SN74126N	.49	SN74197N	.89
SN7441N	.89	SN74132N	.75	SN74198N	1.49
SN7442N	.59	SN74136N	.75	SN74199N	1.49
SN7443N	1.10	SN74141N	.99	SN74221N	1.25
SN7444N	1.10	SN74142N	3.25	SN74251N	.99
SN7445N	.89	SN74143N	3.49	SN74276N	1.95
SN7446N	.79	SN74144N	3.49	SN74279N	.79
SN7447N	.69	SN74145N	.79	SN74283N	1.49
SN7448N	.79	SN74147N	1.95	SN74284N	3.95
SN7450N	.20	SN74148N	1.29	SN74285N	3.95
SN7451N	.20	SN74150N	1.25	SN74365N	.69
SN7453N	.20	SN74151N	.69	SN74366N	.69
SN7454N	.20	SN74152N	.69	SN74367N	.69
SN7459A	.25	SN74153N	.79	SN74368N	.69
SN7460N	.20	SN74154N	1.25	SN74390N	1.49
SN7470N	.29	SN74155N	.79	SN74393N	1.49

74LS

74LS00	.29	74LS92	.75	74LS192	1.15
74LS01	.29	74LS93	.75	74LS193	1.15
74LS02	.29	74LS95	.99	74LS194	1.15
74LS03	.29	74LS96	1.15	74LS195	1.15
74LS04	.35	74LS107	.45	74LS197	1.19
74LS05	.35	74LS109	.45	74LS221	1.19
74LS08	.35	74LS112	.45	74LS240	1.49
74LS09	.35	74LS113	.49	74LS241	1.49
74LS10	.35	74LS114	.49	74LS242	1.49
74LS11	.39	74LS122	.89	74LS243	1.49
74LS12	.35	74LS123	1.25	74LS244	1.49
74LS13	.59	74LS125	.59	74LS245	2.95
74LS14	.99	74LS126	.59	74LS247	1.19
74LS15	.35	74LS132	.99	74LS248	1.19
74LS20	.35	74LS133	.89	74LS249	1.19
74LS21	.35	74LS136	.49	74LS251	.99
74LS22	.35	74LS138	.89	74LS253	.99
74LS26	.35	74LS139	.89	74LS257	.89
74LS27	.35	74LS151	.89	74LS258	.69
74LS28	.35	74LS153	.89	74LS260	.69
74LS30	.35	74LS154	1.75	74LS266	.69
74LS32	.35	74LS155	.89	74LS273	1.95
74LS33	.59	74LS156	.89	74LS279	.89
74LS37	.45	74LS157	.89	74LS283	.89
74LS38	.39	74LS158	.89	74LS290	.99
74LS40	.35	74LS160	1.15	74LS293	.99
74LS42	.89	74LS161	1.15	74LS298	1.25
74LS47	.89	74LS162	1.15	74LS352	1.29
74LS48	1.15	74LS163	1.15	74LS353	1.29
74LS49	1.15	74LS164	1.15	74LS365	.69
74LS51	.35	74LS163	1.15	74LS366	.69
74LS54	.35	74LS164	1.15	74LS367	.69
74LS55	.35	74LS165	1.15	74LS368	.69
74LS73	.45	74LS168	1.19	74LS373	1.95
74LS74	.45	74LS169	1.19	74LS374	1.95
74LS75	.59	74LS170	1.95	74LS375	.89
74LS76	.45	74LS173	.99	74LS386	.69
74LS78	.49	74LS174	.99	74LS393	2.49
74LS83	.89	74LS175	.99	74LS399	2.49
74LS85	1.25	74LS181	2.95	74LS670	2.49
74LS86	.49	74LS190	1.25	81LS95	1.95
74LS90	.69	74LS191	1.25	81LS97	1.95

74S

74S00	.45	74S124	3.95	74S243	3.25
74S02	.45	74S133	.55	74S244	3.25
74S03	.45	74S134	.69	74S251	1.45
74S04	.55	74S135	1.19	74S253	1.45
74S05	.55	74S136	1.75	74S257	1.35
74S08	.50	74S138	1.35	74S258	1.35
74S09	.50	74S139	1.35	74S260	.79
74S10	.45	74S140	.79	74S280	2.95
74S11	.45	74S151	1.35	74S287	3.25
74S15	.45	74S153	1.35	74S288	2.75
74S20	.45	74S157	1.35	74S373	3.49
74S22	.45	74S158	1.35	74S374	3.49
74S30	.45	74S160	2.95	74S387	2.95
74S32	.55	74S174	1.59	74S471	10.95
74S38	1.25	74S175	1.59	74S472	10.95
74S40	.50	74S188	2.95	74S473	10.95
74S51	.45	74S194	1.95	74S474	12.95
74S64	.50	74S195	1.95	74S475	12.95
74S65	.50	74S196	1.95	74S570	5.95
74S74	.75	74S240	2.95	74S571	5.95
74S86	.79	74S241	2.95	74S572	9.95
74S112	.79	74S242	3.25	74S573	9.95
74S113	.79			74S940	3.15
74S114	.79			74S941	3.15

CA–LINEAR

CA3010H	.99	CA3060N	3.25	CA3089N	3.75
CA3013H	2.15	CA3080H	1.25	CA3096N	3.95
CA3023H	3.25	CA3081N	2.00	CA3130H	1.39
CA3035H	2.49	CA3082N	2.00	CA3140H	1.25
CA3039H	1.35	CA3083N	1.60	CA3160H	1.25
CA3046N	1.30	CA3086N	.85	CA3401N	.59
CA3059N	3.25			CA3600N	3.50

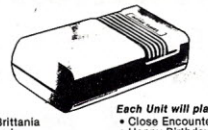
CD–CMOS

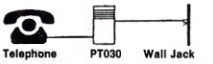
CD4000	.39	CD4041	1.49	CD 4098	2.49
CD4001	.39	CD4042	.99	CD4506	.75
CD4002	.39	CD4043	.89	CD4507	.99
CD4006	1.19	CD4044	.89	CD4508	3.95
CD4007	.25	CD4046	1.79	CD4510	1.39
CD4009	.49	CD4047	2.50	CD4511	1.29
CD4010	.49	CD4048	1.35	CD4512	1.49
CD4011	.39	CD4049	.49	CD4514	3.95
CD4012	.25	CD4050	.69	CD4515	2.95
CD4013	.49	CD4051	1.19	CD4516	1.49
CD4014	1.39	CD4052	1.19	CD4518	1.79
CD4015	1.19	CD4053	1.19	CD4519	.89
CD4016	.59	CD4054	2.95	CD4520	1.29
CD4017	1.19	CD4055	2.95	CD4526	1.79
CD4018	.99	CD4056	2.95	CD4528	1.79
CD4019	.49	CD4059	9.95	CD4529	1.95
CD4020	1.19	CD4060	1.49	CD4543	2.79
CD4021	1.39	CD4066	.79	CD4562	11.95
CD4022	1.19	CD4068	.39	CD4566	2.79
CD4023	.29	CD4069	.45	CD4583	2.49
CD4024	.79	CD4070	.55	CD4584	.75
CD4025	.23	CD4071	.49	CD4723	1.95
CD4026	2.95	CD4072	.49	CD4724	1.95
CD4027	.69	CD4073	.39	MC14409	17.95
CD4028	.89	CD4075	.39	MC14410	18.95
CD4029	1.49	CD4076	1.39	MC14411	15.95
CD4030	.49	CD4078	.55	MC14412	15.95
CD4034	3.49	CD4081	.39	MC14419	7.95
CD4035	.99	CD4082	.39	MC14433	15.95
CD4040	1.49	CD4093	.99	MC14538	2.49
				MC14541	1.95

Phone Tunes

As Seen on "Good Morning America"

Replaces the Telephone Ringer Bell with a Selection of 30 Familiar Tunes





Each Unit will play any of the following tunes:

- Rule Brittania
- O Canada
- Colonel Bogey
- Westminister Chimes
- Mexican Hat Dance
- Twinkle, Twinkle Little Star
- Deutschlandlied
- God Save the Queen
- Close Encounters
- Happy Birthday
- Wedding March
- Jingle Bells
- Auld Lang Syne
- Soldiers Chorus
- Sailor's Hornpipe
- Charge!
- Greensleeves
- Lorelei
- Eyes of Texas
- Star Spangled Banner
- Oranges and Lemons
- Wilhelmus
- Mozart Sonata
- Pomp & Circumstance
- William Tell Overture
- Bach Toccata in D Minor
- Shave and a Haircut
- Blue Danube Waltz
- Beethoven's 5th
- La Marseillaise

FEATURES

Replaces monotonous telephone ringer bell. Easily connects to any standard telephone. Can be used alongside regular phone or replace a remote ringer elsewhere in building or outside. FCC approved. Can be used on any telephone system — worldwide. Use a different tune to identify extension phones. Microprocessor controlled. Adjustable volume control and variable tune speed control. Operates on two 9-volt batteries or AC Adapter (not included).

PT030 Phone Tunes **$49.95**

AD30 AC Adapter **$8.95**

DISCRETE LEDS

XC556R	.200" red	5/$1	MV50	.085" red	6/$1
XC556G	.200" green	4/$1	XC209R	.125" red	5/$1
XC556Y	.200" yellow	4/$1	XC209G	.125" green	4/$1
XC556C	.200" clear	4/$1	XC209Y	.125" yellow	4/$1
XC22R	.200" red	5/$1	XC526R	.185" red	5/$1
XC22G	.200" green	4/$1	XC526G	.185" green	4/$1
XC22Y	.200" yellow	4/$1	XC526Y	.185" yellow	4/$1
MV10B	.170" red	4/$1	XC526C	.185" clear	4/$1

.200(T1¾) Red/Green

Diffused Bi-Color LED

Part No.	1-99	100+
XC5491	.79	.69

XC556 RED LED, METAL MTG. HDW., 2-6" LEADS.

RL-2 . . $.39 ea. or 3/$1.00

DISPLAY LEDS

C.A. — Common Anode
D.D. — Double Digit
C.C. — Common Cathode
RHD — Right Hand Decimal

Type	Polarity	Ht	Price
MAN 1	C.A.—red	.270	2.95
MAN 2	5x7 D.M.—red	.300	4.95
MAN 3	C.C.—red	.125	.25
MAN 52	C.A.—green	.300	.99
MAN 54	C.C.—green	.300	.99
MAN 71	C.A.—red	.300	.75
MAN 72	C.A.—red	.300	.75
MAN 74	C.C.—red	.300	1.25
MAN 82	C.A.—yellow	.300	.49
MAN 84	C.C.—yellow	.300	.99
MAN 3620	C.A.—orange	.300	.49
MAN 3630	C.A.—orange ± 1	.300	.99
MAN 3640	C.C.—orange	.300	.99
MAN 4610	C.A.—orange	.400	.99
MAN 6610	C.A.—orange—DD	.560	.99
MAN 6630	C.A.—orange ± 1	.560	.99
MAN 6640	C.C.—orange—DD	.560	.99
MAN 6650	C.C.—orange ± 1	.560	.99
MAN 6660	C.A.—orange	.560	.99
MAN 6710	C.A.—red—DD	.560	.99
MAN 6740	C.C.—red—DD	.560	.99
MAN 6750	C.C.—red ± 1	.560	.99
DLO304	C.C.—orange	.300	1.25
DLO307	C.A.—orange	.300	1.25
DLG500	C.C.—green	.500	1.25

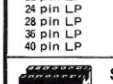
Type	Polarity	Ht	Price
DLG507	C.A.—green	.500	1.25
DL704	C.C.—red	.300	1.25
DL707	C.A.—red	.300	1.25
DL728	C.C.—red	.500	1.49
DL741	C.A.—red	.600	1.25
DL747	C.A.—red	.600	1.49
DL750	C.C.—red	.600	1.49
DLO847	C.A.—orange	.800	1.49
DLO850	C.C.—orange	.800	1.49
DL33B	C.C.—red	.110	.35
FND358	C.C. ± 1	.357	.99
FND357	C.C.	.357	.75
FND500	C.C. (FND503)	.500	.99
FND507	C.A. (FND510)	.500	.99
HDSP-3401	C.A.—red	.800	1.50
HDSP-3403	C.C.—red	.800	1.50
HDSP-3406	C.C. red ±1	.800	1.50
5082-7751	C.A., R.H.D.—red	.430	1.25
5082-7760	C.C., R.H.D.—red	.430	1.25
5082-7300	4x7 Numeric (RHD)	.600	22.00
5082-7302	4x7 Numeric (LHD)	.600	22.00
5082-7340	4x7 Hxdcl. (0-9/A-F)	.600	22.50
4N28	Photo Xsistor Opto-Isol.		.69
LIT-1	Photo Xsistor Opto-Isol.		.69
MOC3010	Optically Isol. Triac Driver		1.25

COMPUTER GRADE CAPACITORS

MFD	WVDC	PRICE	MFD	WVDC	PRICE	MFD	WVDC	PRICE
250	150	1.95	10,000	15	2.95	24,000	20	2.95
500	200	2.49	10,000	16	3.95	27,000	10	2.95
1,250	3	.99	11,000	16	4.95	32,500	25	4.95
1,500	25	1.95	11,000	55	5.49	40,000	25	5.95
1,500	50	2.95	11,000	66	5.95	43,000	10	5.95
2,000	10	2.95	13,000	16	2.95	50,000	20	7.95
2,250	100	3.95	14,000	13	2.95	52,000	20	5.95
2,300	33	2.95	14,000	25	3.95	55,000	15	5.95
2,500	15	2.95	18,000	10	3.95	58,000	20	5.95
3,000	25	1.95	20,000	20	2.95	65,000	10	7.95
3,500	40	3.95	20,000	55	3.95	73,800	5	7.95
4,500	50	3.95	21,000	15	3.95	80,000	15	9.95
5,500	25	4.49	23,000	7	1.95	90,000	10	8.95
6,100	40	4.49	23,000	10	2.95	160,000	10	9.95
6,600	50	4.95	23,000	20	3.95	200,000	3	12.95

OVER 200 OTHER VALUES AVAILABLE — CALL OR WRITE FOR YOUR REQUIREMENT

LOW PROFILE (TIN) SOCKETS



	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5ea.	10 Ohm 27 Ohm	12 Ohm 33 Ohm	15 Ohm 39 Ohm	18 Ohm 47 Ohm	22 Ohm 56 Ohm	50pcs.	$1.95
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ASST. 3	5ea.	470 Ohm 1.2K	560 Ohm 1.5K	680 Ohm 1.8K	820 Ohm 2.2K	1K 2.7K	50pcs.	$1.95
ASST. 4	5ea.	3.3K 8.2K	3.9K 10K	4.7K 12K	5.6K 15K	6.8K 18K	50pcs.	$1.95
ASST. 5	5ea.	22K 56K	27K 68K	33K 82K	39K 100K	47K 120K	50pcs.	$1.95
ASST. 6	5ea.	150K 390K	180K 470K	220K 560K	270K 680K	330K 820K	50pcs.	$1.95
ASST. 7	5ea.	1M 2.7M	1.2M 3.3M	1.5M 3.9M	1.8M 4.7M	2.2M 5.6M	50pcs.	$1.95
ASST. 8R		Includes Resistor Assts. 1-7 (350 pcs.)						$10.95 ea.

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INTERSIL

Part No.	Function	Price
7045IPI	CMOS Precision Timer	14.95
7045EV/Kit*	Stopwatch Chip, XTL	24.95
7106CPL	3½ Digit A/D (LCD Drive)	16.95
7106EV/Kit*	IC, Circuit Board, Display	34.95
7107CPL	3½ Digit A/D (LED Drive)	15.95
7107EV/Kit*	IC, Circuit Board, Display	29.95
7116CPL	3½ Digit A/D LCD Dis. HLD.	18.95
7117CPL	3½ Digit A/D LED Dis. HLD.	17.95
7201IR	Low Battery Volt Indicator	2.25
7205IPG	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7206CEV/Kit*	Tone Generator Chip, XTL	12.95
7207AIPD	Oscillator Controller	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	13.95
7208IPI	Seven Decade Counter	17.95
7209IPA	Clock Generator	3.95
7215IPG	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL	19.95
7216AIJI	8-Digit Univ. Counter C.A.	32.00
7216CIJI	8-Digit Freq. Counter C.A.	26.95
7216DIPI	8-Digit Freq. Counter C.C.	21.95
7217IJI	4-Digit LED Up/Down Counter	12.95
7218CIJI	8-Digit Univ. LED Drive	10.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
8038CCPD	Waveform Generator	4.95
8048CCPE	Monolithic Logarithmic Amp	21.60
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.95
8212CPA	Volt Ref/Indicator	2.95

74C

74C00	.39	74C95	1.59	74C221	1.95
74C02	.39	74C107	1.89	74C240	2.25
74C04	.39	74C151	2.95	74C244	2.25
74C08	.39	74C154	3.95	74C373	2.49
74C10	.39	74C157	2.25	74C374	2.59
74C14	.75	74C160	1.69	74C901	.69
74C20	.39	74C161	1.69	74C903	.69
74C30	.39	74C162	1.49	74C911	10.95
74C42	1.39	74C163	1.69	74C912	10.95
74C48	1.95	74C164	1.59	74C915	1.69
74C73	.79	74C173	1.39	74C917	10.95
74C74	.79	74C174	1.39	74C922	5.49
74C85	1.95	74C175	1.19	74C923	5.75
74C86	.99	74C192	1.69	74C925	7.50
74C89	6.95	74C193	1.69	74C926	7.50
74C90	1.29	74C195	1.59	80C95	.79
74C93	1.29			80C97	.79

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LH0002CN	6.85	LM340T-5	1.25	LM702H	.79
LM10CLH	4.50	LM340T-12	1.25	LM703CN	.89
LM11CLH	4.75	LM340T-15	1.25	LM709N	.29
LH0070-0H	4.95	LM340T-12	1.25	LM710N	.79
TL071CP	.79	LM340T-15	1.25	LM711N	.79
TL072CP	1.39	LM341P-5	.75	LM723N	.69
TL074CN	2.49	LM341P-12	.75	LM733N	1.00
LH0082CD	35.80	LM341P-15	.75	LM739N	1.19
TL082CP	1.19	LM342P-5	.69	LM741CN	.35
TL084CN	2.19	LM342P-12	.69	MC1741SCG	3.00
LH0094CD	36.80	LM342P-15	.69	LM747N	.79
LM300H	.99	LM348N	1.25	LM748N	.59
LM301CN	.35	LM350K	5.75	LM1014N	2.75
LM302H	1.95	LF351N	.60	LM1310N	1.95
LM304H	1.95	LF353N	1.00	LM1458CN	.59
LM305H	.99	LF355N	1.10	LM1488N	1.25
LM307CN	.45	LF356N	1.10	LM1489N	1.25
LM308CN	1.00	LM358N	1.00	LM1496N	1.95
LM309H	1.95	LM359N	1.79	LM1556V	1.75
LM309K	1.25	LM370N	4.49	LM1800N	2.95
LM310CN	1.75	LM373N	3.25	LM1871N	5.49
LM311/CN	.90	LM377N	2.95	LM1872N	5.49
LM312H	2.49	LM380N	1.25	LM1877N-9	3.25
LM317MP	1.15	LM381N	1.95	LM1889N	3.20
LM317T	1.75	LM382N	1.79	LM1896N	1.75
LM317K	3.95	LM384N	1.95	LM2002T	1.49
LM318CN	1.95	LM386N-3	1.29	LM2877P	2.06
LM319N	1.95	LM387N	1.45	LM2878P	2.25
LM320K-5	1.35	LM389N	1.35	LM2896P-1	2.25
LM320K-12	1.35	LM392N	.69	LM3189N	2.95
LM320K-15	1.35	LF398N	4.00	LM3900N	.69
LM320T-5	1.25	LM399H	5.00	LM3905CN	1.25
LM320T-12	1.25	TL494CN	4.49	LM3909N	1.15
LM320T-15	1.25	TL496CP	1.75	LM3914N	3.95
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LM336Z	1.75	NE550A	1.30	LM4500A	3.25
LM337T	1.95	NE555V	.39	ICL8038B	4.95
LM337MP	1.15	LM556N	.99	LM13080N	1.29
LM338K	6.95	NE564N	3.95	LM13600N	1.49
LM339N	.99	LM565N	1.25	75138N	1.95
LM340K-5	1.35	LM566CN	1.95	75450N	.89
LM340K-12	1.35	LM567V	1.25	75451CN	.39
LM340K-15	1.35	NE570N	4.95	75492	.89

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22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.09	.07	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
470 pf	.08	.06	.05	.1µF	.15	.12	.10

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.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

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.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

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Flexible Disc 1s	IBM Compatible (128 B/S, 26 Sectors)	3060	1.99	473071	53428	800506	2305830	FD1-128	FD-1	740-0	S/A 100	15002	FD34-9000	F111111X	421602
Single-Headed Drives	IBM Compatible (128 B/S, 26 Sectors) w/ W P N	3067	2.04	–	–	–	–	–	–	740-0	–	–	FD34-9000	–	–
Single-Density Media	IBM Compatible (128 B/S, 26 Sectors) w/ W P N & Hub Ring	3064	2.39	–	–	–	–	–	–	–	–	–	FD34-9000	–	–
	IBM Compatible (128 B/S, 26 Sectors) REVERSIBLE	1729	3.19	473072	54431	–	–	–	FD-2	740/2-0	–	15150	FF34-9000	F171111X	–
	IBM System 6 Compatible	3066	2.04	473077	54561	800509	1669959	–	–	740-0 056	–	15003	FD60-9000	F116111X	–
	IBM Compatible (256 B/S, 15 Sectors)	3109	1.99	473073	–	800584	2305845	–	–	740-3600	–	15005	FD36-9000	F112111X	–
	IBM Compatible (512 B/S, 8 Sectors)	3110	1.99	473074	–	800585	1669954	–	–	–	–	15004	FD60-9000	F113111X	–
	Shugart Compatible, 32 Hard Sector	3015	1.99	470901	53602	101/1	–	FH1-32	FD-132	740-32	S/A-101	15025	FD32-9000	–	421322
	Wang Compatible, 32 Hard Sector w/Hub Ring	3087	2.49	–	54491	–	–	–	–	740-32RH	–	–	–	F37A411X	–
	CPT 8000 Compatible	3045	2.69	–	–	–	–	–	–	–	–	15226	–	–	–
Flexible Disc 1d	IBM Compatible (128 B/S, 26 Sectors)	3090	2.69	474071	54568	3740/1D	–	FD1-128/M2100	FD-1D	741-0	–	–	FD34-8000	F131111X	423002
Single-Headed Drives	Soft Sector (128 B/S, 26 Sectors) REVERSIBLE	3093	3.69	–	–	–	–	–	–	–	–	–	–	–	–
Double-Density Media	Shugart Compatible, 32 Hard Sector	3091	2.69	470801	54596	101/1D	–	FH1-32D	–	741-32	S/A-103	15075	FJ32-8000	F33A411X	423322
	Wang Compatible, 32 Hard Sector w/Hub Ring	3088	3.09	–	–	–	–	–	–	–	–	–	–	–	–
Flexible Disc 2s	Soft Sector (128 B/S, 26 Sectors)	3113	3.09	–	54428	800814	1766870	–	–	–	S/A-150	15153	FD10-4026	F121111X	–
Double-Headed Drives	Soft Sector (256 B/S, 15 Sectors)	3106	3.09	473477	54226	800815	2736700	FD2-256D	–	742-0	–	15154	FD10-4015	F122111X	424612
Single-Density Media															
Flexible Disc 2d	Soft Sector (Unformatted)	3102	3.09	473485	–	DY150	–	FD2-XDM	FD-2D	743-0	–	15103	DD34-4001	–	425002
Double-Headed Drives	Soft Sector (128 B/S, 26 Sectors)	3115	3.09	–	–	–	–	–	–	–	S/A-150	–	–	–	–
Double-Density Media	Soft Sector (256 B/S, 26 Sectors)	3103	3.09	473471	54325	800817	1766872	FD2-256D	–	743-0/256	–	15101	DD34-4026	F144111X	425602
	Soft Sector (512 B/S, 15 Sectors)	3114	3.09	473472	54479	800818	1669044	–	–	743-0/512	–	15100	DD34-4015	F145111X	425612
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	Burroughs B-80 Compatible, 32 Hard Sector	3092	3.09	–	–	–	–	–	–	–	–	–	–	F34A611X	–
	Soft Sector (1024 B/S, 8 Sectors) w/ Hub Ring	3116	3.49	–	–	–	–	–	–	–	–	–	–	–	–
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	Soft Sector (Unformatted) w/Hub Ring	3431	2.14	–	–	–	–	–	–	–	–	–	MD525-01	–	–
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Mini Flexible Disc 1d	Soft Sector (Unformatted)	3417	2.14	–	54646	104/1D	–	–	–	–	–	–	MD525-01	–	–
5¼" Single-Headed Drives	10 Hard Sector	3418	2.14	–	54649	107/1D	–	–	–	–	–	–	MD525-10	–	–
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	Soft Sector (Unformatted) w/Hub Ring	3481	2.34	–	–	–	–	–	–	–	–	–	MD526-01	–	–
	10 Hard Sector w/Hub Ring	3483	2.34	–	–	–	–	–	–	–	–	–	MD525-10	–	–
	16 Hard Sector w/Hub Ring	3485	2.34	–	–	–	–	–	–	–	–	–	MD525-16	–	–
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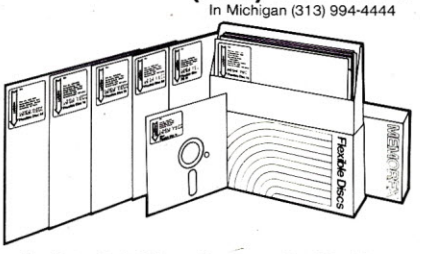

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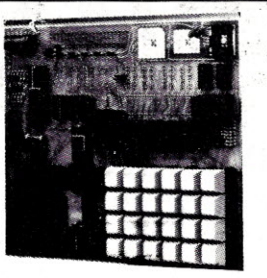
74LS74N	.45	78L05	.60	CD4020	.35	10 MHz	4.25	12.6V CT 4 amp	8.60 12V 1 amp 5.95
74LS75N	.50	78L08	.60	CD4030	.35	18 MHz	3.90	12.6V CT 8 amp	10.80 12V 2 amp 7.95
74LS90N	.60	78M05	.85	CD4048	1.95	20 MHz	3.90	24V CT 100 ma	3.95
74LS93N	.65	75108	1.49	CD4074	.85	32 MHz	3.90	24V CT 600 ma	4.95
74LS95N	.85	75491CN	.50	CD4076	.80	32768 Hz	4.00	**Constant Voltage Transformers** 12V 11 amp	
74LS107N	.40	75492CN	.55	CD4090	1.25	1.8432 MHz	4.50	5V, 23 amp; 24V, 11 amp	15.00
74LS112N	.45	75494CN	.89	CD4093	1.25	2.0000 MHz	1.95		
74LS113N	.45			74C154	3.25	2.097152 MHz	4.50	**DISPLAY LEDS**	
74LS132N	.75	**A to D CONVERTER**		74C160	1.69	2.4576 MHz	4.50	MAN72 7-4	CA CA .300 .75
74LS136N	.49	8038B	4.50	74C175	1.19	3.2768 MHz	4.50	DL704	CC .300 1.25
74LS151N	.75	8700CJ	13.95	74C192	1.65	5.0688 MHz	4.50	DL707 DL707R	CA .300 1.00
74LS155N	.79	8701CN	22.00	74C221	1.90	5.185 MHz	4.50	DL727 728	CA CC .500 1.90
74LS157N	.75	8750CJ	13.95	74C905	6.00	5.7143 MHz	4.50	DL747 750	CA CC .600 1.49
74LS162N	.95	LD130	9.95	74C906	.75	6.5536 MHz	4.50	FND359	CC .357 .70
74LS163N	.95	9400CJV F	7.40	74C914	1.95	14.31818 MHz	4.25	FND500-507	CC CA .500 .99
74LS174N	.95	ICL7103	9.50	74C922	5.00	18.432 MHz	4.50	FND503-510	CC CA .500 .90
74LS190N	1.00	7107	14.25	74C923	5.50	22.1184 MHz	4.50	FND800-807	CC CA .800 2.20
74LS221N	1.19			74C925	6.75			10 digit display	1.25
74LS258N	.69	**CMOS**		74C926	6.95	**KEYBOARD ENCODERS**		7520 Clairex photocells	.39
74LS367N	.69	CD4000	.25	74C927	6.95	AY5-2376	11.95	TIL311 Hex	9.50
		CD4001	.35			AY5-3600	17.95	MAN3640	CC .30 .99
		CD4002	.35	**INTERFACE**		74C922	5.49	MAN4610	CA .40 .99
LINEAR		CD4006	.95	8095	.65	74C923	5.50	MAN4640	CC .40 1.20
CA3045	.90	CD4008	.95	8096	.65	HD0165-5	7.95	MAN4710	CA .40 .95
CA3046	1.10	CD4009	.25	8097	.65			MAN4740	CC .40 1.20
CA3081	1.80	CD4008	.95	8098	.65	**D Connectors RS232**		MAN6640	CC .56 .99
CA3082	1.90	CD4009	.45	8T09	1.25	DB25P	2.95	MAN6710	CA .60 .99
CA3089	3.40	CD4010	.45	8T10	1.75	DB25S	3.50	MAN6740	CC .60 .99
LM301AN/AH	.34	CD4011	.35	8T13	1.40	Cover	1.67		
LM305H	.87	CD4012	.25	8T20	4.95			**TELEVIDEO TERMINAL**	
LM307N	.35	CD4013	.45	8T23	1.75			Model 950	$1010.00
LM308N	.98	CD4014	.95	8T24	1.75				
LM309K	1.25	CD4015	.95	8T25	3.20				
LM311H N	.64	CD4016	.45						

4116 200ns Dynamic RAM 8/$15.40



RCA Cosmac 1802 Super Elf Computer $106.95

The Super Elf is a small single board computer that does many **big** things. It's an excellent computer for training and for learning programming with its machine language and yet it's easily **expanded** with **additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** All metal Expansion Cabinet, painted and silk screened, with room for 5S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

Moews Video Graphics **$3.50,** Games and Music **$3.00**, Chip 8 Interpreter **$5.50,** Starship 4K cassette **$14.95.**

Quest Super Basic V5.0

A new enhanced version of **Super Basic** now available. Quest was the first company worldwide to ship a full size Basic for 1802 Systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range ±.17E^{38}), 32 bit integer ±2 billion; multi dim arrays; string arrays; string manipulation; cassette I/O; save and load, basic, data and machine language programs; and over 75 statements, functions and operations.

New improved faster version including **renumber** and essentially **unlimited variables.** Also, an exclusive user expandable command library.

Serial and Parallel I/O routines included.

Super Basic on Cassette $55.00.

Free 14 page brochure of complete Super Elf system.

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50.** A **50 pin connector set** with ribbon cable is available at **$18.95** for easy connection between the **Super Elf** and the **Super Expansion Board.**

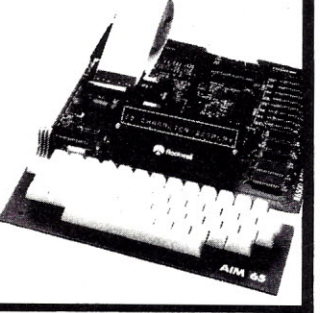
Power Supply Kit for the complete system (see Multi-volt Power Supply below).

Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display ROM monitor,. fully expandable. **$419.00.** 4K version **$449.00**. 4K Assembler **$35.00**, 8K Basic Interpreter **$65.00**.

Special small power supply 5V 2A 24V .5A assem. in frame **$59.00.** Molded plastic enclosure to fit both AIM 65 and power supply **$52.50.** AIM 65 1K in cabinet with power supply, switch, fuse, cord assem. **$559.00.** 4K **$579.00. A65/40-5000 AIM 65/40 w/16K RAM and monitor $1295.00.** RAM Board Kit (16K, **$195**) (32K, **$215**). VD640 Video Interface Kit **$119.00.** A&T **$149.00.** Complete AIM 65 in thin briefcase with power supply **$518.00**. Special Package Price: 4K AIM, 8K Basic, power supply, cabinet **$629.00**

AIM 65/KIM/SYM/Super Elf 44 pin expansion board; board with 3 connectors **$22.95.**



Super Color S-100 Video Kit $129.95

Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, Z80, etc. **Dealers: Send for excellent pricing/margin program.**

ELECTRONIC SYSTEMS KITS

Apple Peripheral Kits

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PARALLEL TRIAC OUTPUT BOARD 8 triacs, each can switch 110V, 6A loads, Bd only (P/N 210) **$19.20,** Kit (P/N 210A) **$119.55.**

OPTO-ISOLATED INPUT BOARD 8 inputs, can be driven from TTL logic, Bd only (P/N 120) **$15.65,** Kit (P/N 120A) **$69.95.**

Interface Kits

SERIAL/PARALLEL INTERFACE Bidirectional, Baud rates from 110 to 19.2K, sw selectable polarity of input and output strobe, 5 to 8 data bits, 1 or 2 stop bits, parity odd or even or none, all characters contain a start bit, +5 & −12V required.Bd only (P/N 101) **$11.95,** Kit (P/N 101A) **$42.89.**

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RS-232/20mA INTERFACE Bidirectional, 2 passive opto-isolated circuits, Kit (P/N 7901A) **$14.95.**

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Type-N-Talk by Votrax

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SN7402N	22	SN7492N	49
SN7404N	21	SN7493N	45
SN7408N	22	SN7495N	50
SN7410N	18	SN7496N	69
SN7412N	20	SN74122N	39
SN7413N	22	SN74136N	95
SN7414N	29	SN74141N	69
SN7416N	27	SN74151N	65
SN7417N	29	SN74153N	58
SN7420N	17	SN74154N	1.25
SN7425N	20	SN74155N	75
SN7430N	17	SN74157N	58
SN7437N	26	SN74160N	89
SN7438N	24	SN74161N	65
SN7440N	18	SN74163N	85
SN7442N	45	SN74164N	87
SN7443N	42	SN74165N	55
SN7445N	64	SN74174N	88
SN7451N	19	SN74175N	79
SN7454N	19	SN74180N	75
SN7474N	27	SN74181N	1.15
SN7475N	35	SN74393N	1.65

74LS00

74LS00	28	74LS158	69
74LS02	28	74LS161	83
74LS03	28	74LS162	89
74LS04	28	74LS163	98
74LS05	22	74LS164	85
74LS08	29	74LS165	65
74LS09	28	74LS169	1.55
74LS10	26	74LS170	1.75
74LS14	89	74LS174	85
74LS20	22	74LS175	85
74LS21	26	74LS190	85
74LS26	40	74LS191	1.25
74LS27	27	74LS195	95
74LS28	.37	74LS197	.78
74LS30	29	74LS221	1.25
74LS32	31	74LS240	1.65
74LS38	31	74LS241	1.65
74LS42	63	74LS243	1.55
74LS48	77	74LS244	1.55
74LS74	38	74LS245	2.45
74LS75	55	74LS251	1.25
74LS86	45	74LS253	85
74LS90	59	74LS257	85
74LS93	65	74LS259	1.95
74LS96	80	74LS260	55
74LS107	43	74LS273	1.55
74LS113	45	74LS279	45
74LS122	45	74LS290	1.25
74LS123	89	74LS293	1.65
74LS125	89	74LS365	85
74LS126	79	74LS367	75
74LS138	64	74LS373	1.45
74LS139	59	74LS374	1.45
74LS151	49	74LS377	1.25
74LS153	49	74LS669	1.55
74LS157	69	74LS670	1.85

74S00

74S00	.39	74S138	.75
74S02	.45	74S140	1.00
74S03	.38	74S158	.75
74S04	.39	74S174	1.35
74S05	.39	74S175	1.35
74S10	.39	74S182	.75
74S15	.45	74S189	4.25
74S20	.55	74S201	6.75
74S22	.55	74S240	2.75
74S30	.75	74S244	2.95
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74S50	.55	74S287	2.95
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7905	.85		
7906	.85		
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MC1330A1P	1.60		
MC1350P	1.15		
MC1358P	1.50		
LM380	1.10		
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10/5.70	16	10/1.40
10/8.70	18	10/1.80
10/9.70	20	10/2.70
10/12.70	22	10/2.70
10/13.70	24	10/2.70
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10/17.70	40	10/3.90
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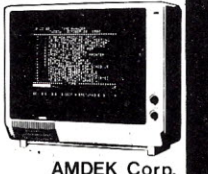

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Master Reversi is a tournament-winning game program that has more features than any other reversi program on the market. It will challenge and teach you no matter what your degree of expertise.

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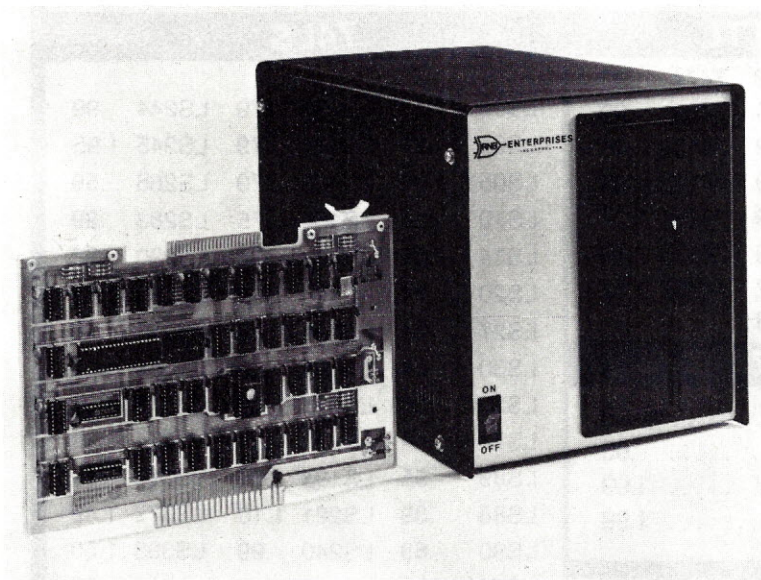
VAK-7 8" FLOPPY DISK SYSTEM

FOR AIM-65, SYM-1



The VAK-7 Disk System was specifically designed for use with AIM-65 and SYM-1 Microcomputer Systems. The VAK-7 is a complete full size (8") Floppy Disk System. This system will Read, Write and Format IBM Single and Dual Density diskettes. The VAK-7 is available with both Single and Dual Sided Disk Drives. Each Disk Drive comes with its own cabinet and Power Supply. The VAK-7 can handle up to 4 disk drives, totaling more than 4.98 Megabytes of storage.

The VAK-7 Disk System incorporates both advanced hardware and innovative software designs. The addition of the VAK-7 produces a very powerful and useful computer system. Unlike most other disk systems, there is no requirement for the user to provide RAM to hold the Disk Operating System software. No valuable time is wasted loading in the DOS from cassette tape, because the VAK-7 DOS software is in onboard ROM. The VAK-7 is located above the 32K boundary (8000 HEX), leaving the user with a full 32K bytes of contiguous address space for his own use.

AIM-65—Allows the user to save and load object code thru the AIM Monitor; to load, save, and append Text thru the AIM Editor; to load, save, and append Basic Programs thru the BASIC INTERPRETER; to assemble directly from disk single or multiple file programs.

SYM-1—Allows the user to save and load Files for use with the SYM Monitor, SYM Basic, and RAE-1.

ADDITIONAL COMMANDS:

ACTIVATE A DELETED FILE
COMPRESS A DISK
RENAME A DISK FILE
COPY A DISK
FORMAT A DISK
DELETE A DISK FILE
INITIALIZE A DISK
LIST CATALOG

SPECIFICATIONS:

- Completely assembled, tested, and burned in.
- Occupies address 8000-8FFF for AIM-65, $9000-9FFF for SYM-1, or $E000-EFFF for KIM-1.
- IBM Format; Single Density (128 bytes/sector); Dual Density (256,512, or 1024 bytes/sector).
- All ICs are in sockets.
- Fully buffered address and data bus.
- Standard KIM-4* BUS (both electrical pin-out and card size).
- Designed for use with a regulated power supply, but has provisions for adding regulators for use with an unregulated power supply.
- Dimensions: Board—10" wide x 7" high (including card-edge). Cabinet—9.25" wide x 10" high x 16" deep.
- Power Requirements: +5v DC @ 2 Amps.
  117 AC 60Hz @ 2 Amps.
- Shipping Weight: 25 lbs.

*KIM-4 is a product of MOS Technology/C.B.M.

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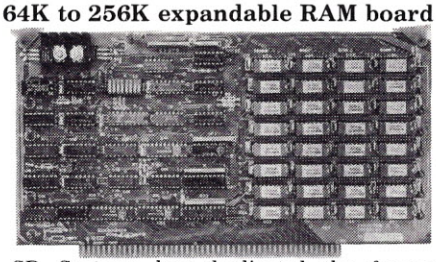
4 MHz Z-80A CPU, 64K RAM, serial I/O port, parallel I/O port, double-density disk controller, CP/M 2.2 disk and manuals, system monitor, control and diagnostic software.

-All boards are assembled and tested-

ExpandoRAM III

64K to 256K expandable RAM board



SD Systems has duplicated the famous reliability of their ExpandoRAM I and II boards in the new ExpandoRAM III, a board capable of containing 256K of high speed RAM. Utilizing the new 64K x 1 dymanic RAM chips, you can configure a memory of 64K, 128K, 192K, or 256K, all on one S-100 board. Memory address decoding is done by a programmed bipolar ROM so that the memory map may be dip-switch configured to work with either COSMOS/MPM-type systems or with OASIS-type systems.

Extensive application notes concerning how to operate the ExpandoRAM III with Cromemco, Intersystems, and other popular 4 MHz Z-80 systems are contained in the manual.

MEM-65064A *64K A & T* **$495.00**
MEM-65128A *128K A & T* **$639.95**
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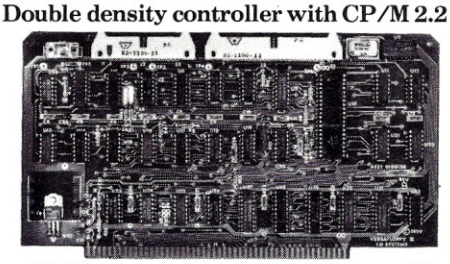
MEM-65256A *256K A & T* **$879.95**

Versafloppy II

Double density controller with CP/M 2.2



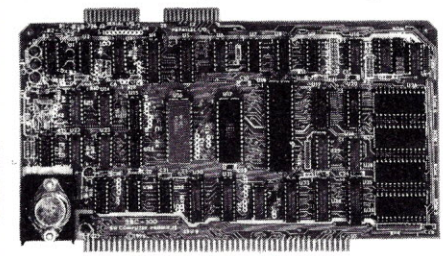
• S-100 bus compatible • IBM 3740 compatible soft sectored format • Controls single and double-sided drives, single or double density, 5¼" and 8" drives in any combination of four simultaneously • Drive select and side select circuitry • Analog phase-locked loop data seperator • Vectored interrupt operation optional • CP/M 2.2 disk and manual set included • Control/diagnostic software PROM included

The Versafloppy II is faster, more stable and more tolerant of bit shift and "jitter" than most controllers. CP/M 2.2 and all necessary control and diagnostic software are included.

IOD-1160A *A & T with CP/M 2.2* .. **$370.00**

SBC-200

2 or 4 MHz single board computer



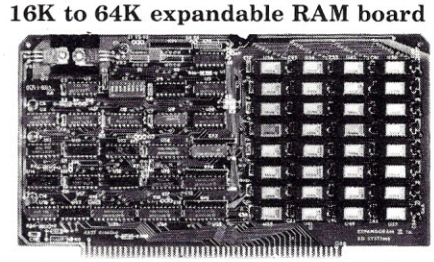
• S-100 bus compatible • Powerful 4MHz Z-80A CPU • Synchronous/asynchronous serial I/O port with RS-232 interface and software programmable baud rates up to 9600 baud • Parallel input and parallel output port • Four channel counter/timer • Four maskable, vectored interrupt inputs and a non-maskable interrupt • 1K of on-board RAM • Up to 32K of on-board ROM • System monitor PROM included

The SBC-200 is an excellent CPU board to base a microcomputer system around. With on-board RAM, ROM, and I/O, the SBC-200 allows you to build a powerful three-board system that has the same features found in most five-board microcomputers. The SBC-200 is compatible with both single-user and multi-user systems.

CPU-30200A *A & T with monitor* . **$299.95**

ExpandoRAM II

16K to 64K expandable RAM board



• S-100 bus compatible • Up to 4MHz operation • Expandable from 16K to 64K • Uses 16 x 1 4116 memory chips • Page mode operation allows up to 8 memory boards on the bus • Phantom output disable • Invisible on-board refresh

The ExpandoRAM II is compatible with most S-100 CPUs. When other SD System' series II boards are combined with the ExpandoRAM II, they create a microcomputer system with exceptional capabilities and features.

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COSMOS

Multi-user operating system

• Multi-user disk operating system • Allows up to 8 users to run independent jobs concurrently • Each user has a seperate file directory

COMOS supports all the file structures of CP/M 2.2, and is compatible at the applications program level with CP/M 2.2, so that most programs written to run under CP/M 2.2 or SDOS will also run under COSMOS.

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Multi-User System

SBC-200, 256K ExpandoRAM III, Versafloppy II, MPC-4 COSMOS Multi-User Operating System, C BASIC II

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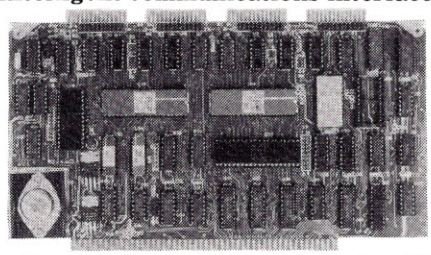
Two Z-80A CPUs (4 MHz), 256K RAM, 5 serial I/O ports with independently programmable baud rates and vectored interrupts, parallel input port, parallel output port, 8 counter/timer channels, real time clock, single and double sided/single or double density disk controller for 5¼" and 8" drives, up to 36K of on-board ROM, CP/M 2.2 compatible COSMOS interrupt driven multi-user disk operating system, allows up to 8 users to run independent jobs concurrently, C BASIC II, control and diagnostic software in PROM included.

-All boards are assembled and tested-

MPC-4

Intelligent communications interface



• Four buffered serial I/O ports • On-board Z-80A processor • Four CTC channels • Independently programmable baud rates • Vectored interrupt capability • Up to 4K of on-board PROM • Up to 2K of on-board RAM • On-board firmware

This is not just another four-port serial I/O board! The on-board processor and firmware provide sufficient intelligence to allow the MPC-4 to handle time consuming I/O tasks, rather than loading down your CPU. To increase overall efficiency, each serial channel has an 80 character input buffer and a 128 character output buffer. The on-board firmware can be modified to make the board SDLC or BISYNC compatible. In combination with SD's COSMOS operating system (which is included with the MPC-4), this board makes a perfect building block for a multi-user system.

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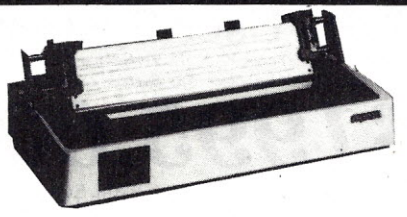

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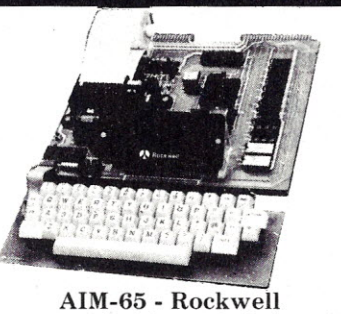
IOM-5400A *Smartmodem* **$269.95**

Single Board Computer



AIM-65 - Rockwell

6502 computer with alphanumeric display, printer, & keyboard, and complete instructional manuals

CPK-50165 *1K AIM* **$424.95**
CPK-50465 *4K AIM* **$474.95**
SFK-74600008E *8K BASIC ROM* .. **$64.95**
SFK-64600004E *4K assembler ROM* **$43.95**
PSX-030A *Power supply* **$64.95**
ENX-000002 *Enclosure* **$54.95**

4K AIM, 8K BASIC, power supply, & enclosure

Special package price **$649.95**

Z-80 STARTER KIT - SD Systems

Complete Z-80 microcomputer with RAM, ROM, I/O, keyboard, display, kludge area, manual, & workbook

CPS-30100K *KIT* **$299.95**
CPS-30100A *A & T* **$469.95**

SYM-1 - Synertek Systems

Single board computer with 1K of RAM, 4K of ROM, key-pad, LED display, 20ma & cassette interface on board.

CPK-50020A *A & T* **$249.95**

Video Monitors

HI-RES 12" GREEN - Zenith

15 MHz bandwidth, 700 lines/inch, P31 green phosphor, switchable 40 or 80 columns, small, light-weight & portable.

VDM-201201 *List price $150.00* **$118.95**

Leedex / Amdek

Reasonably priced video monitors

VDM-801210 *Video 100 12" B&W* .. **$139.95**
VDM-801230 *Video 100-80 12" B& W* **$179.95**
VDM-801250 *12" Green Phospor* **$169.95**
VDC-801310 *13" Color I* **$379.95**

12" COLOR MONITOR - NEC

Hi-res monitor with audio & sculptured case

VDC-651212 *Color Monitor* **$479.95**

12" GREEN SCREEN - NEC

20 MHz, P31 phosphor video monitor with audio, exceptionally high resolution - A fantastic monitor at a very reasonable price

VDM-651200 *Special Sale Price* **$199.95**

Video Terminals

AMBER SCREEN - Volker Craig

Detachable keyboard, amber on black display, 7 x 9 dot matrix, 10 program function keys, 14 key numeric pad, 12" non-glare screen, 50 to 19,200 baud, direct cursor control, auxiliary bi-directional serial port

VDT-351200 *List $795.00* **$645.00**

VIEWPIONT - ADDS

Detachable keyboard, serial RS232C interface, baud rates from 110 to 19,200, auxiliary serial output port, 24 x 80 display.

VDT-501210 *Sale Priced* **$639.95**

TELEVIDEO 950

VDT-901250 *List $1195.00* **$995.00**

DIALOGUE 80 - Ampex

VDT-230080 *List $1195.00* **$895.00**

JADE
Computer Products

S-100 CPU Boards

THE BIG Z* - Jade
2 or 4 MHz switchable Z-80 CPU with serial I/O, accomodates 2708, 2716, or 2732 EPROM, baud rates from 75 to 9600*

CPU-30201K *Kit* **$139.95**
CPU-30201A *A & T* **$189.95**
CPU-30200B *Bare board* **$35.00**

2810 Z-80* CPU - Cal Comp Sys
2/4 MHz Z-80A CPU with RS-232C serial I/O port and on-board MOSS 2.2 monitor PROM, front panel compatible.*

CPU-30400A *A & T* **$269.95**

CB-2 Z-80 CPU - S.S.M.
2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board, extended addressing, IEEE S-100, front panel compatible.

CPU-30300K *Kit* **$239.95**
CPU-30300A *A & T* **$299.95**

S-100 PROM Boards

PROM-100 - SD Systems
2708, 2716, 2732 EPROM programmer w/software

MEM-99520K *Kit* **$189.95**
MEM-99520A *A & T* **$249.95**

PB-1 - S.S.M.
2708, 2716 EPROM board with built-in programmer

MEM-99510K *Kit* **$154.95**
MEM-99510A *A & T* **$219.95**

EPROM BOARD - Jade
16K or 32K uses 2708's or 2716's, 1K boundary

MEM-16230K *Kit* **$79.95**
MEM-16230A *A & T* **$119.95**

S-100 Video Boards

VB-3 - S.S.M.
80 characters x 24 lines expandable to 80 x 48 for a full page of text, upper & lower case, 256 user defined symbols, 160 x 192 graphics matrix, memory mapped, has key board input.

IOV-1095K *4 MHz kit* **$349.95**
IOV-1095A *4 MHz A & T* **$439.95**
IOV-1096K *80 x 48 upgrade* **$39.95**

VDB-8024 - SD Systems
80 x 24 I/O mapped video board with keyboard I/O, and on-board Z-80A.*

IOV-1020A *A & T* **$459.95**

VIDEO BOARD - S.S.M.
64 characters x 16 lines, 128 x 48 matrix for graphics, full upper/lower case ASCII character set, numbers, symbols, and greek letters, normal/reverse/blinking video, S-100.

IOV-1051K *Kit* **$149.95**
IOV-1051A *A & T* **$219.95**
IOV-1051B *Bare board* **$34.95**

S-100 Motherboards

ISO-BUS - Jade
Silent, simple, and on sale - a better motherboard

6 Slot (5¼" x 8⅝")

MBS-061B *Bare board* **$19.95**
MBS-061K *Kit* **$39.95**
MBS-061A *A & T* **$49.95**

12 Slot (9¾" x 8⅝")

MBS-121B *Bare board* **$29.95**
MBS-121K *Kit* **$69.95**
MBS-121A *A & T* **$89.95**

18 Slot (14½" x 8⅝")

MBS-181B *Bare board* **$49.95**
MBS-181K *Kit* **$99.95**
MBS-181A *A & T* **$139.95**

S-100 RAM Boards

MEMORY BANK - Jade
4 MHz, S-100, bank selectable, expandable from 16K to 64K

MEM-99730B *Bare Board* **$49.95**
MEM-99730K *Kit no RAM* **$199.95**
MEM-32731K *32K Kit* **$239.95**
MEM-64733K *64K Kit* **$279.95**
Assembled & Tested ..... add **$50.00**

64K RAM - Calif Computer Sys
4 MHz bank port / bank byte selectable, extended addressing, 16K bank selectable, PHANTOM line allows memory overlay, 8080 / Z-80 / front panel compatible.

MEM-64565A *A & T* **$575.00**

64K STATIC RAM - Mem Merchant
64K static S-100 RAM card, 4-16K banks, up to 8MHz

MEM-64400A *A & T* **$789.95**

32K STATIC RAM - Jade
2 or 4 MHz expandable static RAM board uses 2114L's

MEM-16151K *16K 4 MHz kit* **$169.95**
MEM-32151K *32K 4 MHz kit* **$299.95**
Assembled & tested ..... add **$50.00**

16K STATIC RAM - Mem Merchant
4 MHz 16K static RAM board, IEEE S-100, bank selectable, Phantom capability, addressable in 4K blocks, "disable-able" in 1K segments, extended addressing, low power

MEM-16171A *A & T* **$164.95**

S-100 Disk Controllers

DOUBLE-D - Jade
Double density controller with the inside track, on-board Z-80A, printer port, IEEE S-100, can function on an interrupt driven buss*

IOD-1200K *Kit* **$299.95**
IOD-1200A *A & T* **$375.00**
IOD-1200B *Bare board* **$59.95**

DOUBLE DENSITY - Cal Comp Sys
5¼" and 8" disk controller, single or double density, with on-board boot loader ROM, and free CP/M 2.2 and manual set.*

IOD-1300A *A & T* **$374.95**

S-100 I/O Boards

S.P.I.C. - Jade
Our new I/O card with 2 SIO's, 4 CTC's, and 1 PIO

IOI-1045K *2 CTC's, 1 SIO, 1 PIO* .. **$179.95**
IOI-1045A *A & T* **$239.95**
IOI-1046K *4 CTC's, 2 SIO's, 1 PIO* **$219.95**
IOI-1046A *A & T* **$299.95**
IOI-1045B *Bare board w/ manual* ... **$49.95**

I/O-4 - S.S.M.
2 serial I/O ports plus 2 parallel I/O ports

IOI-1010K *Kit* **$179.95**
IOI-1010A *A & T* **$249.95**
IOI-1010B *Bare board* **$35.00**

S-100 Mainframes

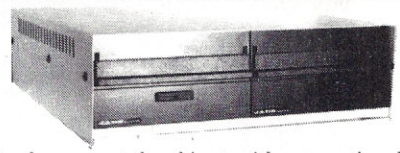
MAINFRAME - Cal Comp Sys
12 slot S-100 mainframe with 20 amp power supply

ENC-112105 *Kit* **$329.95**
ENC-112106 *A & T* **$399.95**

DISK MAINFRAME - N.P.C.
Holds 2 8" drives and a 12 slot S-100 system. Attractive metal cabinet with 12 slot motherboard & card cage, power supply, dual fans, lighted switch, and other professional features

ENS-112325 *with 25 amp p.s.* **$699.95**

Disk Drives



Handsome metal cabinet with proportionally balanced air flow system • Rugged dual drive power supply • Power cable kit • Power switch, line cord, fuse holder, cooling fan • Never-Mar rubber feet • All necessary hardware to mount 2-8" disk drives, power supply, and fan • Does not include signal cable

Dual 8" Subassembly Cabinet

END-000420 *Bare cabinet* **$59.95**
END-000421 *Cabinet kit* **$225.00**
END-000431 *A & T* **$359.95**

8" Disk Drive Subsystems
Single Sided, Double Density

END-000423 *Kit w/2 FD100-8Ds* . **$924.95**
END-000424 *A & T w/2 FD100-8Ds* **$1124.95**
END-000433 *Kit w/2 SA-801Rs* ... **$999.95**
END-000434 *A & T w/2 SA-801Rs* **$1195.00**

8" Disk Drive Subsystems
Double Sided, Double Density

END-000426 *Kit w/2 DT-8s* **$1224.95**
END-000427 *A & T w/2 DT-8s* ... **$1424.95**
END-000436 *Kit w/2 SA-851Rs* .. **$1495.00**
END-000437 *A & T w/2 SA-851Rs* **$1695.00**

QUME DT-8
8" Double-Sided, Double-Density Disk Drive

1 Drive ... $524.95 each
2 Drives . $499.95 each
10 Drives $479.95 each

Jade Part Number MSF-750080

Shugart 801R
8" Single-Sided, Double-Density Disk Drive

1 Drive ... $394.95 each
2 Drives . $389.95 each

Jade Part Number MSF-10801R

SIEMENS 8"
8" Single-Sided, Double-Density Disk Drive

1 Drive ... $384.95 each
2 Drives . $349.95 each
10 Drives $324.95 each

Jade Part Number MSF-201120

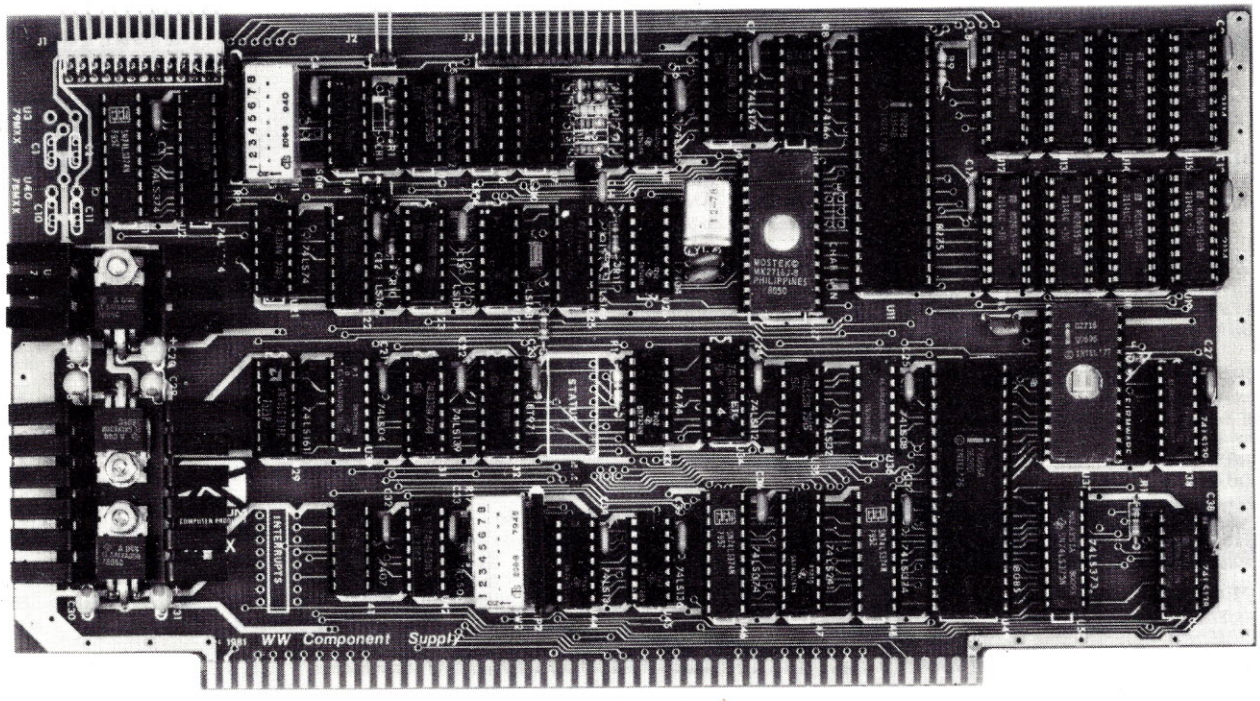
MPI B-51
5¼" Single-Sided, Double-Density Disk Drive

1 Drive ... $234.95 each
2 Drives . $224.95 each
10 Drives $219.95 each

Jade Part Number MSM-155100

END-000213 *Case & power supply* **$74.95**

INTELLIGENT VIDEO I/O FOR S-100 BUS



VIO-X

The VIO-X Video I/O Interface for the S-100 bus provides features equal to most intelligent terminals both efficiently and economically. It allows the use of standard keyboards and CRT monitors in conjunction with existing hardware and software. It will operate with no additional overhead in S-100 systems regardless of processor or system speed.

Through the use of the Intel 8275 CRT controller with an onboard 8085 processor and 4k memory, the VIO-X interface operates independently of the host system and communicates via two ports, thus eliminating the need for host memory space. The screen display rate is effectively 80,000 baud.

The VIO-X1 provides an 80 character by 25 line format (24 lines plus status line) using a 5 × 7 character set in a 7 × 10 dot matrix to display the full upper and lower case ASCII alphanumeric 96 printable character set (including true descenders) with 32 special characters for escape and control characters. An optional 2732 character generator is available which allows an alternate 7 × 10 contiguous graphics character set.

The VIO-X2 also offers an 80 character by 25 line format but uses a 7 × 7 character set in a 9 × 10 dot matrix allowing high-resolution characters to be used. This model also includes expanded firmware for block mode editing and light pen location. Contiguous graphics characters are not supported.

Both models support a full set of control characters and escape sequences, including controls for video attributes, cursor location and positioning, cursor toggle, and scroll speed. An onboard Real Time Clock (RTC) is displayed in the status line and may be read or set from the host system. A checksum test is performed on power-up on the firmware EPROM.

Video attributes provided by the 8275 in the VIO-X include:

- FLASH CHARACTER
- INVERSE CHARACTER
- UNDERLINE CHARACTER or
- ALT. CHARACTER SET
- DIM CHARACTER

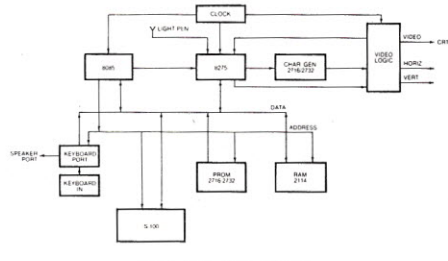
The above functions may be toggled together or separately.

The board may be addressed at any port pair in the IEEE 696 (S-100) host system. Status and data ports may be swapped if necessary. Inputs are provided for parallel keyboard and for light pen as well as an output for audio signalling. The interrupt structure is completely compatible with Digital Research's MP/M ®.

Additional features include:

- HIGH SPEED OPERATION
- PORT MAPPED IEEE S-100 INTERFACE
- FORWARD/REVERSE SCROLL or
- PROTECTED SCREEN FIELDS
- CONVERSATIONAL or BLOCK MODE (opt)
- INTERRUPT OPERATION
- CUSTOM CHARACTER SET
- CONTROL CHARACTERS
- ESCAPE CHARACTER COMMANDS
- INTELLIGENT TERMINAL EMULATION
- TWO PAGE SCREEN MEMORY

VIO-X1 - 80 × 25 5 ×7 A & T **$295.00**
Conversational Mode
VIO-X2 - 80 × 25 7 × 7 A & T **$345.00**
Conversational & Block Modes



VIO-X S-100 I/O INTERFACE

FULCRUM™ COMPUTER PRODUCTS

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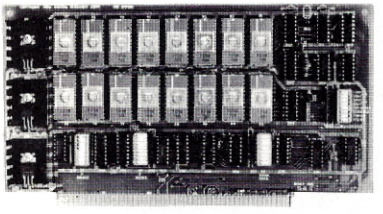
✓285

DIGITAL RESEARCH COMPUTERS
(214) 271-3538

32K S-100 EPROM CARD
NEW!



$79.95 KIT

USES 2716's

Blank PC Board - $34

ASSEMBLED & TESTED ADD $30

SPECIAL: 2716 EPROM's (450 NS) Are $9.95 Ea. With Above Kit.

KIT FEATURES:
1. Uses +5V only 2716 (2Kx8) EPROM's.
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks.
5. Cromemco extended or Northstar bank select.
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

32K SS-50 RAM

$299.00 KIT

For 2MHZ Add $10

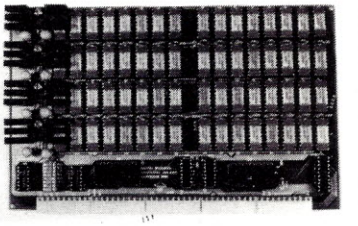
Blank PC Board $50

For SWTPC 6800 - 6809 Buss

Support IC's and Caps $19.95

Complete Socket Set $21.00

Fully Assembled, Tested, Burned In Add $30



At Last! An affordable 32K Static RAM with full 6809 Capability.

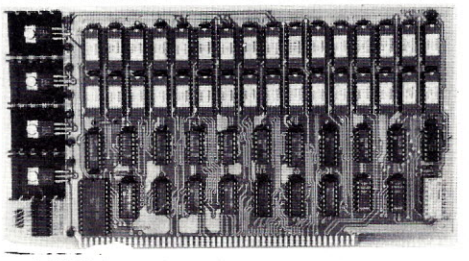
FEATURES:
1. **Uses proven low power 2114 Static RAMS.**
2. **Supports SS50C - EXTENDED ADDRESSING.**
3. **All parts and sockets included.**
4. **Dip Switch address select as a 32K block.**
5. **Extended addressing can be disabled.**
6. **Works with all existing 6800 SS50 systems.**
7. **Fully bypassed. PC Board is double sided, plated thru, with silk screen.**

16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

$169.95 KIT

FOR 4MHZ ADD $10



KIT FEATURES:
1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-**$33**

LOW PROFILE SOCKET SET-**$12**

SUPPORT IC'S & CAPS-**$19.95**

ASSEMBLED & TESTED-**ADD $35**

OUR #1 SELLING RAM BOARD!

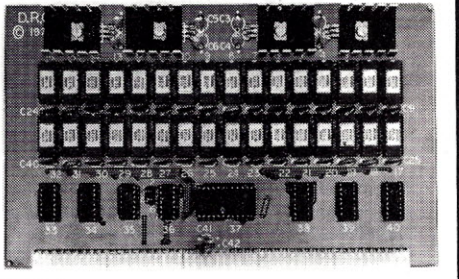
16K STATIC RAM SS-50 BUSS

PRICE CUT!

$159 KIT

FULLY STATIC!

FOR 2MHZ ADD $10



FOR SWTPC 6800 BUSS!

ASSEMBLED AND TESTED - $35

KIT FEATURES:
1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board. Solder mask and silk screened layout
5. All Parts and Sockets included
6. Low Power: Under 1.5 Amps Typical

BLANK PC BOARD—**$35** COMPLETE SOCKET SET—**$12**
SUPPORT IC'S AND CAPS—**$19.95**

NEW! STEREO! S-100 SOUND COMPUTER BOARD NEW!

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

COMPLETE KIT! $84.95 (WITH DATA MANUAL)

BLANK PC BOARD W/DATA $31

KIT FEATURES:
- ★ TWO GI SOUND COMPUTER IC'S.
- ★ FOUR PARALLEL I/O PORTS ON BOARD.
- ★ USES ON BOARD AUDIO AMPS OR YOUR STEREO.
- ★ ON BOARD PROTO TYPING AREA.
- ★ ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
- ★ PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
- ★ EASY, QUICK, AND FUN TO BUILD. WITH FULL INSTRUCTIONS.
- ★ USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.

Both Basic and Assembly Language Programming examples are included.

SOFTWARE:

SCL™ is now available! Our Sound Command Language makes writing Sound Effects programs a SNAP! SCL™ also includes routines for Register-Examine-Modify, Memory-Examine-Modify, and Play-Memory. SCL™ is available on CP/M* compatible diskette or 2708 or 2716. Diskette - **$24.95** 2708 - **$19.95** 2716 - **$29.95.** Diskette includes the source. EPROM'S are ORG at E000H. **(Diskette is 8 Inch Soft Sectored)**

SPECIAL PURCHASE!

UART SALE!

TR1602B — SAME AS TMS6011, AY5-1013, ETC. 40 PIN DIP

TR1602B

$2.95 EACH **4 For $10.00**

CRT CONTROLLER CHIP

SMC #CRT 5037. PROGRAMMABLE FOR 80 x 24, ETC. VERY RARE SURPLUS FIND. WITH PIN OUT. $12.95 EACH.

4K STATIC RAM

National Semi. MM5257. Arranged 4K x 1. +5V, 18 PIN DIP. A Lower Power, Plug in Replacement for TMS 4044. 450 NS. Several Boards on the Market Will Accept These Rams. SUPER SURPLUS PURCHASE! **PRIME NEW UNITS!**

8 FOR $16 32 FOR $59.95

NEW! G.I. COMPUTER SOUND CHIP

AY3-8910. As featured in July, 1979 BYTE! A fantastically powerful Sound & Music Generator. Perfect for use with any 8 Bit Microprocessor. Contains: 3 Tone Channels. Noise Generator, 3 Channels of Amplitude Control. 16 bit Envelope Period Control, 2-8 Bit Parallel I/O. 3 D to A Converters, plus much more! All in one 40 Pin DIP. Super easy interface to the S-100 or other busses. **$11.95 PRICE CUT!**

SPECIAL OFFER: ~~$14.95~~ each Add $3 for 60 page Data Manual.

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ALL SALES ARE MADE SUBJECT TO THE TERMS OF OUR 90 DAY LIMITED WARRANTY. A COPY OF THIS WARRANTY IS AVAILABLE FREE, ON REQUEST.

*TRADEMARK OF DIGITAL RESEARCH. WE ARE NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.

NEW!

"THE BIG BOARD"

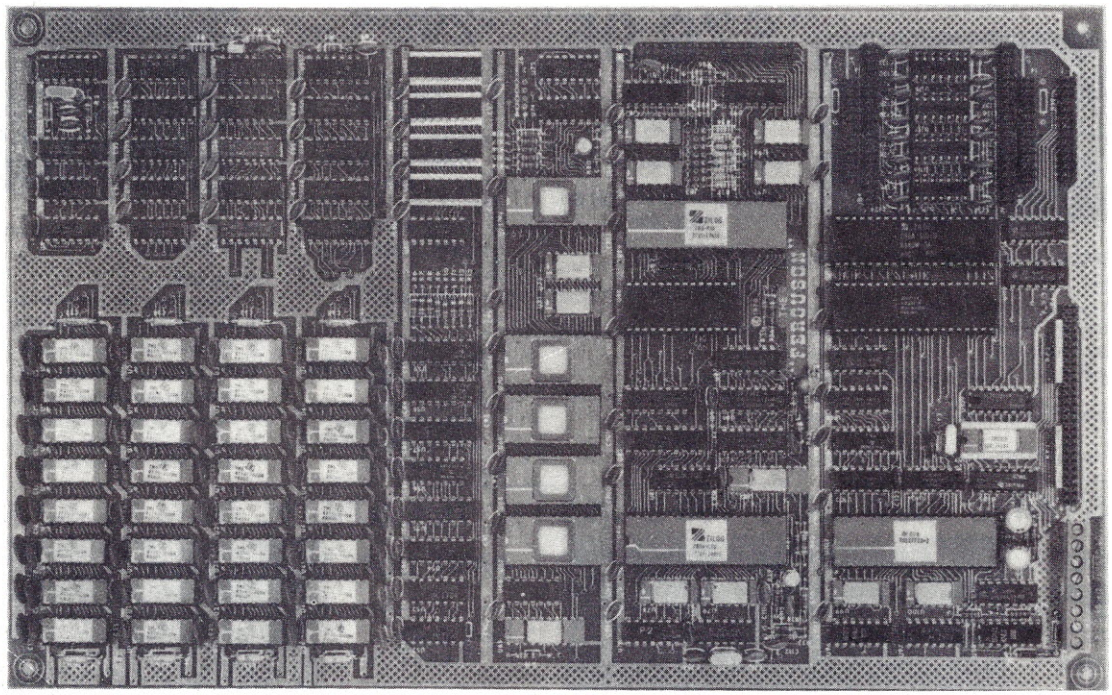
OEM - INDUSTRIAL - BUSINESS - SCIENTIFIC

SINGLE BOARD COMPUTER KIT!

Z-80 CPU! 64K RAM!

NEW!

PARTIALLY ASSEMBLED KITS
For All Sockets Installed
And Soldered Add $50.



THE FERGUSON PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, an enclosure, C.R.T., and you have a total Business System for about 1/3 the cost you might expect to pay.

$649.00 ** (64K KIT BASIC I/0)

SIZE: 8½ x 13¾ IN.
SAME AS AN 8 IN. DRIVE.
REQUIRES: +5V @ 3 AMPS
+ - 12V @ .5 AMPS.

FULLY SOCKETED!

FEATURES: (Remember, all this on one board!)

64K RAM

Uses industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERUPTS. Fully buffered and runs 8080 software.

SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: $85.

BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix - Upper & Lower Case

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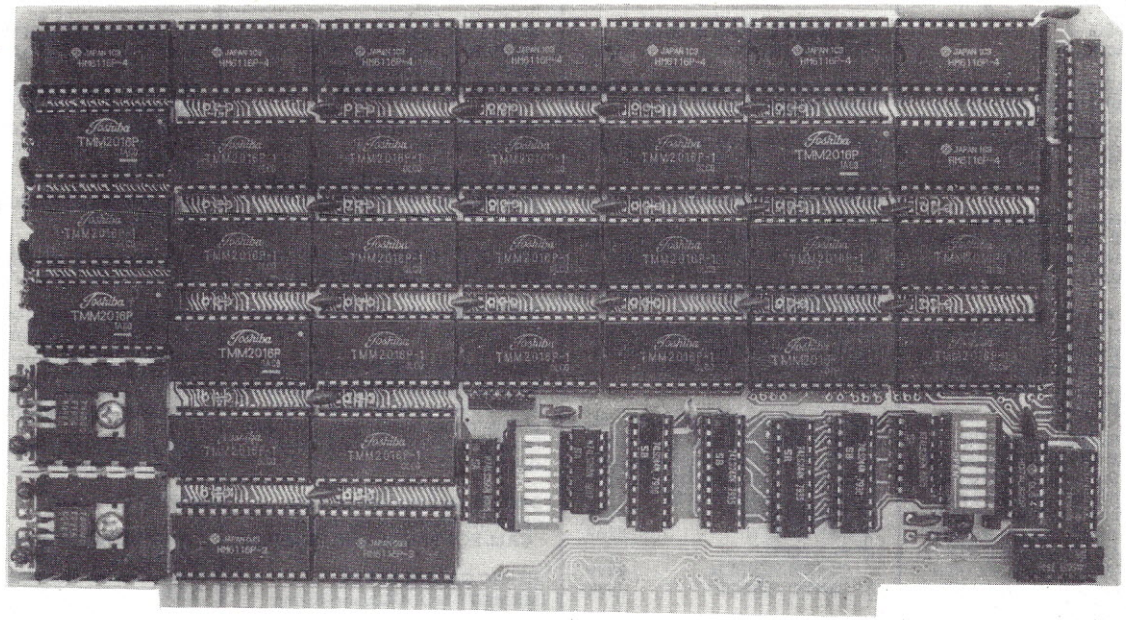

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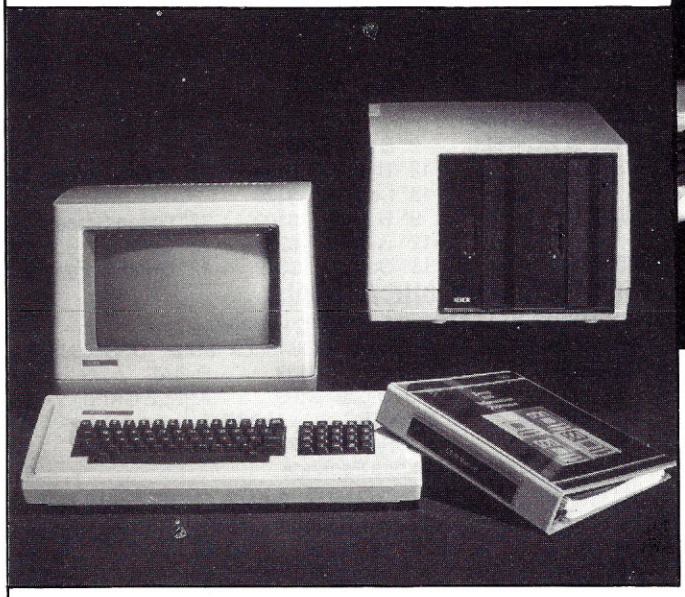

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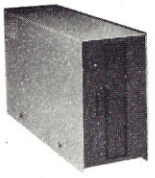

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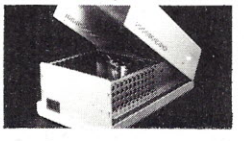

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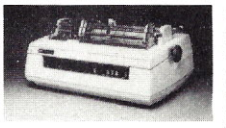

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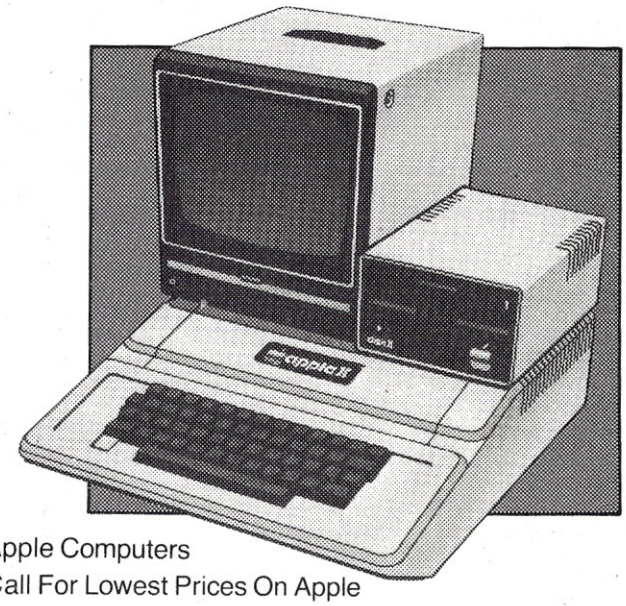

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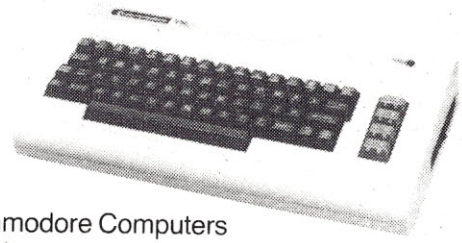

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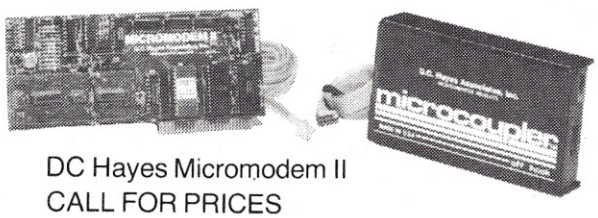

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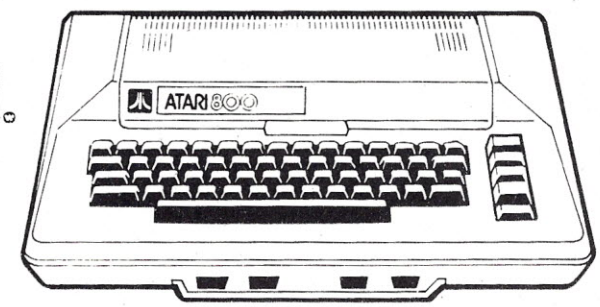

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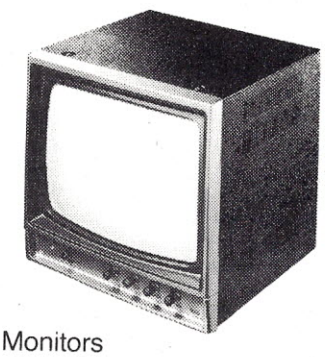

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LETTERS TO THE EDITOR

NTS Molasses

I found J.C. Hassall's article in the Oct. 1981 issue of *Microcomputing* ("Become a Troubleshooter—In 34 Easy Lessons," p. 182) most interesting, and, in a sense, comforting because I am also caught in the grip of the National Technical Schools molasses-like administration. My experience so far with NTS seems to be no better, and in one respect worse, than Mr. Hassall's. (I am enrolled for VA educational assistance reimbursement—the GI Bill—and NTS seems unable to properly handle the few additional bits of paperwork required by the VA!)

There is one bit of confusion in Mr. Hassall's article. NTS actually has (at least they did when I enrolled in April 1981) three microcomputer courses which eventually result in the student getting a Heath HN-89A computer. Course No. 1 is the long course (28 months to complete) without advanced standing; the cost is $2875 at the $75/month payment rate, $2632 at the $100/month rate. Course No. 1B (with advanced standing) has an estimated completion time of 25 months and costs $2576/$2381 at the payment rates mentioned. Course No. 1D (with advanced standing) has an estimated completion time of 18 months and costs $2278/$2130 at the foregoing payment rates. The difference between 1D and 1B is partly that 1D gets only the HN-89A computer, while 1B also gets the NTS "Compu-Trainer" and a digital logic probe.

In my view, the NTS 1D course is worth the money—provided the student is prepared to be patient with the slowness and confusion of NTS administration, and is not expecting to depend on NTS advisors for special help. Frankly, they don't seem to know what they're doing, at least in respect to microcomputers. The NTS advertisements are still saying that the Heath All-In-One Computer can have up to 32K bytes of memory!

I am especially disturbed by the "examination" system used by NTS. As Mr. Hassall said, almost all of the questions are really quoted statements from the text. Often they are used completely out of context in that the quotation is from discussion of a specific example in the text, but its use in an examination implies a general applicability that is false. The examination technique using quotations forces the student only to scan the text for the key words, but requires him/her to actually understand or learn nothing.

So far, I have pointed out to NTS eight outright errors in their grading of examination questions, or in the wording of questions that resulted in more than one correct answer. In one case, a question quoted an error in the text (which misstated the meaning of the letters ASCII) indicating to me that the staff preparing and reviewing the examination questions know little or nothing about their subject!

My conclusion is that it is entirely up to the student to get his money's worth of learning from the NTS microcomputer course. He cannot even rely on the examinations, which should normally be a major part of the educational process.

Elmer A. Goetsch
Three Lakes, WI

I have received mail every day since the October issue came out with the National Technical Schools review "Become a Troubleshooter—In 34 Easy Lessons," p. 182. Every writer experienced the same problems which I described. Most indicated that, while the treatment described in the article is inexcusable, there is solace in the knowledge that others have been given the treatment.

I sent a courtesy copy of the article to Mr. R. Hessler, the manager of student services, inviting his comments. Three months later he responded that my "... comments are being studied and we will use them in making adjustments to the microcomputer course." New students who wrote indicate that no improvements have resulted from the article, so apparently I failed in my attempt to improve the situation through the "power of the pen."

Therefore, I suggest all students who are having trouble to send a letter to the National Home Study Council, 1601 18th Street N.W., Washington, D.C. 20009. I understand that these people certify home study schools. Include in the letter as much substantiating documentation as possible. Angry diatribes with no corroboration will have little effect. A word to G.I. Bill students: send a letter to the VA with the same information, also. They may reconsider the school's certification.

Beyond that, all I can say to presently enrolled students is either make a lot of phone calls to Mr. Hessler, or expect to wait. Eventually the kits will arrive. Good luck.

J.C. Hassall
Blacksburg, VA

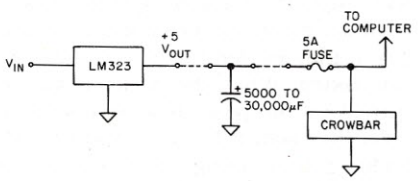

Fig. 1. Power supply modification.

Still Won't Burn

I have just read your reply to Ron Hassinger on p. 16 of the March 1981 issue. I wish to remind him that his 2 A fuse still won't burn.

He must be aware that a fuse rating at 2 A means it is specified to carry 2 A safely. The fusing current for a 2 A fuse is 4 A. Please note that fusing current is always double the rating current.

Further, the 2 A fuse he uses draws too much voltage and will upset his computer. (A 2 A fuse usually measures 0.2 or 0.3 ohms.) *That's why OSI supplied him with a 5 A fuse.*

To blow his 5 A fuse from a 3 A power supply, he must add a large value capacitor to the output point of his power supply as shown in Fig. 1. The extra capacitor will supply the current to blow the 5 A fuse when his crowbar works.

Charn-Leung Kong
Hong Kong

Lazy Writer Rave

I completely sympathize with the complaints in your October *Microcomputing* editorial: as a businessman I know what it's like trying to use a computer at a work station that wasn't designed for somebody who has more to do than enter data all day. But I think you're shortchanging your system with the remark, "I find (a typewriter) better for most of my writing than the slower word processing systems."

I'm a fast typist, too. I used to write news for a TV station and I frequently write advertising copy for pocket money now. When I was in college I had a job as a secretary; at one time I was clocked at 65 words a minute. Most typewriters are too slow for my fingers.

About a year ago I purchased Lazy Writer, a word processing program by David Welsh, for my TRS-80 Model I. It's wonderful. Even though my machine has the old style (mechanical contact) keyboard, the processor keeps up with my fastest bursts of inspiration. Words wrap around the screen before I can say them in my head. Changes and revisions

are easy in the text entry mode, and almost automatic in the editing mode. In fact, the only software I've ever owned that I was this happy with was the stuff I wrote myself.

The publisher is also good about documentation (my Lazy Writer manual is almost half an inch thick) and terrific with support. When an upgrade was issued six months after I bought the program, they mailed me a copy—without my asking. When the package was returned by the post office as undeliverable, they sent it UPS. I suspect if UPS hadn't gotten through, they would have strapped it to a Saint Bernard.

In fact, the only problem I've had with the system (other than hardware problems; it's an old TRS-80) was with the upgrade. I like to use NEWDOS; the upgrade was released on TRSDOS, and I had some problems transferring one of the files. When I explained my problem to Therese Welsh (and sent her a few bucks to cover media and mailing), she mailed me a NEWDOS disk and a spare TRSDOS disk, just in case.

Lazy Writer offers straight and formatted disk saves, complete printer support, full editing, and even a module that'll process text in and out of an RS-232 board for communications. The publishers run their business as well as I try to run mine. If you're still convinced that you can write faster on your IBM, get a copy from them.

Jay Rose
Boston, MA

Plotting Data Revised

In the March 1980 issue of *Microcomputing* the article "Plotting Data or Functions" by Dr. Gordon W. Wolfe (page 167) contained a program for plotting a graph (in SWTP 8K BASIC) which we have revised and use almost every day in our engineering work.

The TRS-80 version that we use is shown in the Program listing. A sample problem printout is also shown.

This program combines Listings 1 and 3 from Dr. Wolfe's article as our work involves plotting X-Y coordinates rather than functions.

The only difference between Dr. Wolfe's original program and our version (other than changes in format due to the differences in BASIC) is that we have used −1, −1 as the flags to indicate the completion of coordinate entrances. This enables the plotting of (0,0), the origin of the X-Y coordinate axis, where desired (as in the sample problem).

The only difference between our TRS-80 version and an OSI MicroSoft BASIC version that we also use is that line 9870 (TAB(3)) in the TRS-80 version becomes TAB (5) in the OSI version.

Bernard L. Golding, PE
Orlando, FL

Program listing.

```
5 DIM T1(60,2)
10 T2=0
20 INPUT"X,Y COORDINATE";X,Y
30 T2=T2+1
31 T1(T2,1)=X
32 T1(T2,2)=Y
40 IF X<>-1 THEN 20
50 IF Y<>-1 THEN 20
51 T2=T2-1
55 PRINT:PRINT
56 FOR I=1 TO T2
60 PRINT T1(I,1),T1(I,2)
65 NEXT I
70 PRINT:PRINT
80 INPUT "X TITLE";X$
90 INPUT "Y TITLE";Y$
95 PRINT:PRINT
9520 PRINT TAB(10);Y$
9530 T3=9E-9:T5=T3
9540 T4=9E+9:T6=T4
9550 FOR I1=1 TO T2
9560 IF T1(I1,2)>T3 THEN T3=T1(I1,2)
9570 IF T1(I1,1)>T5 THEN T5=T1(I1,1)
9580 IF T1(I1,2)<T4 THEN T4=T1(I1,2)
9590 IF T1(I1,1)<T6 THEN T6=T1(I1,1)
9600 NEXT I1
9610 U5=INT(2.3*LOG(ABS(T3)))
9620 PRINT TAB(9);T4;TAB(56);T3
9630 PRINT TAB(10);
9640 FOR I1= 1 TO 53
9650 PRINT "-";
9660 NEXT I1
9665 PRINT
9685 U8=1
9690 T8=(T5-T6)/40
9700 T9=(T3-T4)/50
9710 FOR I1=1 TO 40
9720 U9=ASC(X$)
9730 IF U9=0 THEN U9=32
9740 X$=MID$(X$,2)
9741 IF X$="" THEN X$=" "
9745 U7=T6+(I1-1)*T8
9760 PRINT CHR$(U9);CHR$(32);
9762 PRINT USING"###.##";U7;
9763 PRINT CHR$(33);
9764 IF U8+1>=T2 THEN 9766
9765 IF U7>T1(U8+1,1) THEN U8=U8+1
9766 IF I1=40 THEN 9780
9770 IF U7<T1(U8,1) THEN9840
9780 U6=INT((T1(U8,2)-T4)/T9-.01)
9785 IF U6<=0 THEN 9820
9790 FOR I2=1 TO U6
9800 PRINT CHR$(32);
9810 NEXT I2
9820 PRINT CHR$(42)
9825 U8=U8+1
9830 GOTO 9860
9840 PRINT CHR$(32)
9860 NEXT I1
9870 PRINT TAB(3);T5
9880 END
```

Sample run.

```
X,Y COORDINATE? 0,0
X,Y COORDINATE? 10,40
X,Y COORDINATE? 20,100
X,Y COORDINATE? 30,80
X,Y COORDINATE? 40,60
X,Y COORDINATE? 50,40
X,Y COORDINATE? 60,20
X,Y COORDINATE? 70,10
```

More →

Sample run continued.

```
X,Y COORDINATE? 80,0
X,Y COORDINATE? -1,-1

 0              0
 10             40
 20             100
 30             80
 40             60
 50             40
 60             20
 70             10
 80             0

X TITLE? X-AXIS
Y TITLE? Y-AXIS

          Y-AXIS
          0                                                  100
          ---------------------------------------------------------
X   0.00!*
-   2.00!
A   4.00!
X   6.00!
I   8.00!
S  10.00!                    *
   12.00!
   14.00!
   16.00!
   18.00!
   20.00!                                                    *
   22.00!
   24.00!
   26.00!
   28.00!
   30.00!                                          *
   32.00!
   34.00!
   36.00!
   38.00!
   40.00!                                *
   42.00!
   44.00!
   46.00!
   48.00!
   50.00!                    *
   52.00!
   54.00!
   56.00!
   58.00!
   60.00!          *
   62.00!
   64.00!
   66.00!
   68.00!
   70.00!     *
   72.00!
   74.00!
   76.00!
   78.00!*
    80
```

Dealer's Fault?

I was surprised to see the letter by Duncan Moyer in your November issue (p. 211). I too have bought an Osborne. The problem Mr. Moyer had (additonal charge for setup) must have been just a problem he had with his local dealer. I bought mine through Computer Center in Rochester, NY. The dealer was helpful from the time I first inquired about the Osborne until the final delivery. The only extra costs I encountered were the New York state sales tax. There was no setup or any other extra charges. I have not had the opportunity to test his warranty repair, as the machine has functioned perfectly since I have had it. The problem Mr. Moyer has is not with Osborne Computer Corp. but rather with a dealer attempting to make a few extra bucks.

William L. Roberts
Brooktondale, NY

Where to Turn?

My business uses a Cromemco Z2 computer and I have had three years of good service with it. However, this summer a piece broke in the PerSci disk drive and I have been unable to get it fixed. I have written PerSci, Cromemco, an advertiser in the Cromemco User's Group Newsletter, as well as having a local dealer try to get the part for me.

Cromemco did answer my letter after about six weeks, but offered no help. PerSci has yet to be heard from. The advertiser answered promptly, but did not sell parts. The local dealer drew a blank with PerSci, also.

So I limp along with a single drive, not knowing where to turn. Cromemco is doing well, probably best of the S-100 companies, and I see that PerSci has a new prestigious ad out. But can they compete with IBM without spare parts support?

Malcolm Gillis, president
MEGA Corporation
Toney, AL

Literature Appreciation

After reading the review of Stan Kelly-Bootle's *The Devil's DP Dictionary* by John Edwards (*Microcomputing*, Oct. 1981, p. 260), it is my studied opinion that the review should have never been allowed to reach print. It is obvious that Mr. Edwards did not (or more likely was unable to) understand the context within which, and the viewpoint from which, the *Devil's DP Dictionary* was written.

One's earliest training in literature appreciation concerns the idea of reading the introduction or preamble (if one is provided). If Mr. Edwards had done this, he would have learned that the book was intended to be sort of an appendix of technical terms to Ambrose Bierce's *Devil's Dictionary*. Bierce's book expounds on words common to all human experience, therefore its humor is accessible to everyone. Kelly-Bootle's concerns itself with those terms in the common experience of the mainframe computer world not those in the world of the micro "baby boom." In both cases, the humor is witty and subtle. Not of the type that clubs one over the head as Mr. Edwards seems to require. If the reader is not intimately familiar with the words and phrases and their real meanings, much of the humor could fly right over their heads. It is easy to get some help from a knowledgeable friend as I did (and, apparently, as Mr. Edwards did not). About the only point on which I concur is that the price is a bit high. But the group to which the book is directed (long-time dp professionals) is still rather small compared to the prospective audience for a Harold Robbins novel. The economics of scale apply.

Welbrey A. Hill, Jr.
Tallahassee, FL

Beware the New Electronic Media
Intro for 6800 Experimenters
Stargazer's Guide to Computing

Electronic Nightmare: The New Communications And Freedom

John Wicklein
Viking Press, 1981
Hardcover, 282 pp., $14.95

Is there life after high tech? John Wicklein thinks so—but as the title of this book indicates, he doesn't think it's going to be handed to us on a platter.

Wicklein, a former *New York Times* editor and once a programmer for several TV stations, foresees a wide range of problems arising from what he calls the "multifaceted, integrated communications system" offered by modern electronic communications.

"The new technologies of communication *can* provide great benefits to society—I have no doubt about that," he says. "But unless we plan carefully for their arrival, rather than let them hit us head-on, the threats they bring with them may outweigh the benefits we may enjoy."

In particular, Wicklein is afraid that electronic media will lead to serious abuses of our right to privacy. Corporations or the government could compile a highly detailed profile of anyone who uses videotext systems for home banking, shopping and information retrieval. Such a dossier could, for instance, tell any interested party whether you'd bought books that espoused unpopular political views. It could tell to what causes you had made contributions. It could provide details on who you associated with, what products you bought and what magazines you read. Two-way television—such as the Qube system in Columbus, OH—offers other possibilities. The central computer can, for instance, keep careful track of what you watch, or monitor the views you express during interactive programs.

But the potential problems don't end here. Consider, for example, the ease with which this information could be made available. No laws currently prevent corporations from selling such dossiers to anyone with the money. Furthermore, it is a simple matter to tap communications lines without the knowledge of either the citizen or the host computers. And finally, a system could select from its database what Wicklein calls "guidance" items "to apply a corrective to the subscriber's mindset" if that subscriber is deemed to have objectionable political opinions.

Such a scenario seems, on the surface, to be absurd. But two prominent names in recent American history prove different—Joseph McCarthy and Richard Nixon. It was McCarthy who used seemingly innocent facts to persecute innocent citizens, and it was Richard Nixon who tried to systematically undermine our right to freedom of expression and belief through illegal wiretaps and surveillance.

Even Wicklein's proposal that information could be prescreened to correct a citizen's opinions doesn't seem so ridiculous when one considers the extent to which the Moral Majority and other conservative groups are trying to control what Americans see, hear and read. (Wicklein points to a case in which five dictionaries were pulled from the shelves of a Texas school because they contained too many objectionable words. What would the Moral Majority think about an electronic encyclopedia that included details about the human reproductive system?)

Privacy is not the only issue Wicklein tackles. He also discusses, for example, the question of who will provide and control information that will be transmitted to American homes. Does videotext fall within the regulative boundaries of the Federal Communications Commission? If so, will newspapers that transfer to new electronic media slowly lose their First Amendment right to freedom of the press? If a monolithic communications system develops in the hands of a megacorporation like AT&T, how can we be sure that the news will not be censored to support that corporation's self-serving vision of the world?

Also, who will have access to such a system? Will citizen's organizations and individuals be able to use it for a reasonable price? Will people with questionable political opinions be given a fair chance to use the medium?

Wicklein is committed to the idea that AT&T should not be allowed to operate as both a carrier and information-provider. He points to enormous problems in calling to account "the world's largest private corporation with an annual budget and revenues greater than most countries of the world."

Wicklein continues: "The temptation of such a powerful entity to influence, to interfere with, or subtly or openly to try to control the content of the nation's news and information lifeline over which it had been given exclusive jurisdiction would be very great indeed."

If Wicklein had stopped with these major questions, he would have had himself a substantial book. Unfortunately, he tries to cover a number of other issues: the impact of modern telecommunications on social relationships, whether governments and corporations will tend to centralize or decentralize, whether rich countries and multinational corporations will use information extracted from less-developed countries for national and commercial gain, and the impact of satellite technology. While Wicklein intended his book to be an overview of the potential dangers of electronic media, he tries to cover far too much. By the end of the book, the reader is following far too many threads of thought, and Wicklein fails to tie them up satisfactorily.

Nevertheless, *Electronic Nightmare* offers some important insights into the potential ramifications of the new electronic media. We would do well to remember Wicklein's concluding sentence:

"None of the potential benefits of the new communications will come about unless we shape the technology to human ends and not let it shape us in a commercial or authoritarian mold."

Eric Maloney
***Microcomputing* staff**

Microcomputer Experimentation with the Motorola MEK 6800D2

Lance A. Leventhal
Prentice-Hall, Inc., 1981
Softcover, 438 pp.

Microcomputer Experimentation with the MEK 6800D2 is a good introductory text on microcomputers and also offers material for the more advanced student or hobbyist. The book is set up so that the reader can carry out the problems and examples on an MEK 6800D2 microcomputer, a 6800-based machine-language computer with a keyboard and seven-segment LED displays. This computer has a well-thought-out monitor program and doesn't require a CRT terminal, making it a good low-cost tool for individual or class study.

The text is clearly written and well organized. Each chapter covers a particular topic and introduces terms and 6800 instructions as required. Many of the examples and problems involve running programs on the MEK 6800D2 as is; others require a small amount of additional hardware such as LEDs, TTL ICs and switches. The hardware additions are minor in nature and are well documented so they should pose little problem, even for the novice. The author often presents both hardware and software approaches to the same problem and discusses the trade-offs in cost, development time and performance. The examples in the book which I ran on the computer were bug free, which supports the statement on the back cover that the examples are fully tested.

The first five chapters cover use of the MEK 6800D2 JBUG monitor commands as well as simple input and output using switches and LEDs. Switch debouncing as well as output to seven-segment displays are discussed using both hardware and software methods. Later chapters cover how to handle tables of data using 6800 machine or assembly language, flowcharting and debugging, the use of breakpoints and single stepping, and binary and BCD arithmetic. Chapters A–F treat slightly more advanced topics including subroutines and stack, I/O (using handshaking), interrupts, timing methods, serial I/O and microcomputer timing and control. Topics are covered clearly from the ground up with examples and problems to be carried out on the MEK 6800D2.

Of particular interest to me were discussions of the proper use of the stack, the JBUG monitor subroutines, subtleties of various instructions, changing of parameters on the stack using indexed addressing and the use of timing loops to determine the rate of incoming serial data. The chapter on serial I/O was particularly good because the examples used the on-board UART hooked up in a loop-back mode allowing you to send and receive serial data and get a feel for the process.

This book is set up to teach microcomputer techniques by having the reader try the problems and examples on his own system. Although it doesn't include any full blown projects, you should be well prepared to use a microcomputer in your own application after you finish the book.

The only shortcoming I can find with the book is that its dedication to one microcomputer may discourage its use by other 6800 microcomputer users. I recommend it as a text for an introductory microcomputer lab course. Owners of other 6800-based systems will also find the book of interest if they plan to use it for reference only, or don't mind modifying the examples and problems to run on their particular machine.

Peter W. Marcus
Miami, FL

Manual of Computer Programming for Astrologers

Michael Erlewine
The American Federation of Astrologers
Tempe, AZ, 1981
Paperback, 218 pp., $13.95

This book is valuable for two groups of people: astrology buffs and students of BASIC programming.

The opening sections deal with all the fundamentals one would expect to be covered in a good primer: direct versus programming (or deferred) modes, variables, arrays, operators, hierarchy of operations, error messages, editing, etc. Erlewine's treatment of these basic concepts is lucid and concise.

A valuable feature of the book is its reference section of BASIC keywords. This is like an extremely abridged edition of Lien's BASIC Handbook. It contains a rundown of the Microsoft keywords, and describes how different dialects accomplish similar functions. For example, both the TRS-80's INKEY$ and the PET's and Apple's GET statements are covered. The information is also summarized in a BASIC language reference list.

Erlewine's section on compacting is one of the best treatments I've seen on the venerable art of squeezing that last byte of programming into your dwindling memory reserves.

After covering the basics, Erlewine goes on to deal with program planning and flow. One of the advantages of his approach is that the student learns modular structure from the start. Every function performed by Erlewine's programs, from planetary calculations to keyboard input, is contained in discrete subroutines. These routines may be chosen and combined by students to custom tailor their own programs with whatever features they desire.

While the features described above make this book useful to any beginning BASIC programmer, the manual is especially valuable to those who are interested in astrological, or even straight astronomical, calculations.

A few years ago I wanted to write a program to draw astrological charts. My search for the algorithms for calculating planetary motions proved frustrating. Before dropping the project, I checked city and college libraries. I also made a trip to NYC's Hayden Planetarium to use their special astronomical reference section. I could find no material to even help me get a handle on the raw mathematics involved, let alone predigested computer algorithms.

The manual is especially valuable to those who are interested in astrological, or even straight astronomical, calculations.

This book provides three different routines and databases for calculating planetary motions. The three methods differ in precision, memory-use, speed and date range. One accepts any dates from 4713 B. C. forward and is accurate to within one degree. Another may be used only for dates between A.D. 1900 and A.D. 2000, but is accurate to within several minutes of arc, is quite fast and easily fits into 8K. The third is accurate to within one minute of arc. Routines are also given for the moon and its nodes, asteroids and the Uranian planets.

Some of the other topics covered are progressions, returns, relocations, aspects, midpoints and sorts. House systems supported are Regiomontanus, Porphyry, Equal, Morinus, Koch, Topocentric, Campanus and Placidus. Attention is given to formatting the output and representing a chart on a video monitor.

One warning note: The book states that all its routines are copyrighted and that while they may be freely used by the student in his own programs, they must not be sold. So if you are planning to use this book to create your own commercial astrological software, be prepared to comprehend the ideas involved and write your own programs from the algorithms up.

The Manual of Computer programming may be purchased for $13.95 from Matrix Software, 315 Marion Ave., Big Rapids, MI 49307.

Paul Weiner

NEW PRODUCTS

Edited by Linda Stephenson

Get It Together with Apple Sound Synthesis for Heath New Sinclair, North Star Micros

Apple Organizer

The Apple-Center from Doss Enameling Company, 1224 Mariposa St., San Francisco, CA 94107, was designed to house an Apple computer, a 9-inch monitor and two disk drives. The circuitry protects your Apple from voltage surges, and a cooling fan prevents overheating. A key-locking on/off switch prevents unwanted use. The monitor is angled for comfortable viewing, and the organizer's flat top provides a handy place for an extra monitor or a printer. The price will be approx. $300. Reader Service number 482.

Heath/Zenith Sound Effects

Create sound effects for games or play music from your keyboard. Multiple programmable sound generators using the General Instruments AY3-8910 psg chip are available for Heath/Zenith computers. This chip can produce a wide variety of complex sounds under software control. The psgx2 for the Z/H-89 has two psg chips, plugs into P504 or P505 of the H-89 bus and uses any decoded port address. The psgx4 contains four of these chips and plugs directly into the H8 bus. Each board comes with a speaker and features a built-in audio monitor amplifier and crystal time base. Multiple chips give multiple complex sounds, and each chip offers two eight-bit parallel I/O ports, which have been pinned out on the board. The psgx2 costs $125 and the psgx4 costs $225, plus $5 for shipping and handling.

Mako Data Products, 1441-B N. Red Gum, Anaheim, CA 92806. Reader Service number 486.

Portable Computer From Sinclair

Sinclair Research Ltd., 2 Sinclair Plaza, Nashua, NH 03061, has introduced the ZX81 microcomputer. The Sinclair ZX81 is based upon an innovative four-chip design, and it measures just 6 × 6.5 × 1.5 inches and weighs 12 ounces. It has an 8K-byte BASIC ROM, enabling it to operate in decimal arithmetic with full scientific functions. A 40-key touch-sensitive membrane keyboard gives the equivalent of 91 keys using function mode and single-press keyword system. Graphics mode enables an additional 20 graphical and 54 inverse video characters. Programs can be loaded and saved on any home cassette player. A 16K RAM attaches to the

The Apple-Center from Doss Enameling Company.

The Sinclair ZX81 microcomputer.

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Chart shows total capacity in Bytes for 2 drives.

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↙See List of Advertisers on page 178

back of the ZX81 to expand the size of the computer's memory. Assembled price is $149.95; kit is $99.95. Reader Service number 483.

It's About Time

Hayes Microcomputer Products, Inc., 5835 Peachtree Corners East, Norcross, GA 30092, has introduced the Hayes Stack Chronograph, an RS-232-compatible calender/clock for microcomputers. The Chronograph quartz-crystal control adds precise timekeeping to computer systems. With the Chronograph and user-developed software, your computer can log programs and reports by day, date and time. The Chronograph can also provide information to control lights, burglar alarms and sprinkler systems. To cut the cost of electronic mail, the user can develop programs to batch messages during the day and send them at night when telephone rates are lowest. The system, including Chronograph unit, power pack, three AA batteries and owner's manual, costs $249. Reader Service number 484.

The Hayes Stack Chronograph from Hayes Products, Inc.

Heath/Zenith
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A directory to Heath/Zenith compatible products, The Information Center Sourcebook features over 200 pages of abstracts and listings, including:

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Axiom Corporation's Model EX-1650 printer.

Electronic Notepad

Axiom's Model EX-1650 printer produces full-sized hard copy directly from a video input device, such as a video computer terminal, graphics terminal, video monitor or TV set. Any displayed data, including complex graphics, alphanumeric data in any size or font, foreign symbols or even hieroglyphics can be quickly reproduced on electrosensitive paper. The printer operates from the composite video information displayed on the screen, and requires only a single connection to a standard video jack. No external hardware or software is required. Price is $3495.

Axiom Corporation, 5932 San Fernando Road, Glendale, CA 91202.

Business Computing

The MicroMaster from Barreto and Associates, Inc., 507 West 16, Sedalia, MO 65301, is a self-contained desktop computer. It operates under a modified CP/M, and is designed for use in small and intermediate businesses. The system is IEEE S-100 based, and contains both a 5¼-inch 5 megabyte Winchester drive and a floppy drive. Standard 64K-byte random access memory is expandable to 16 megabytes. The system can be configured for single or multiple users. The 12-inch monitor has an 80 character by 24 line format. The unit's multiprocessor architecture and special operating system speed operation. The MicroMaster sells for $12,500. Reader Service number 488.

Publications of Note

A helpful publication on school use of microcomputers is available from the Project Planning Centre, Ministry of Education, Legislative Buildings, Victoria, BC V8V 1X4. The discussion paper, "Instructional Use of Microcomputers: A Report on BC's Pilot Project," is an 80-page document which outlines the results of an innovative test project in British Columbia's schools. Reader Service number 492.

The *Turtle News* is offered, free, to subscribers under 18 years of age. The monthly newsletter is published by the Young People's Logo Association, 1208 Hillsdale Drive, Richardson, TX 75081, to bring together young programmers using Logo and other languages. It will promote educational and recreational use of microcomputers,

The MicroMaster business microcomputer from Barreto and Associates.

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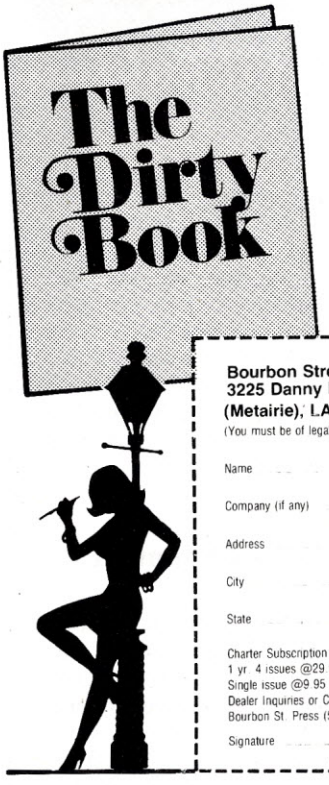

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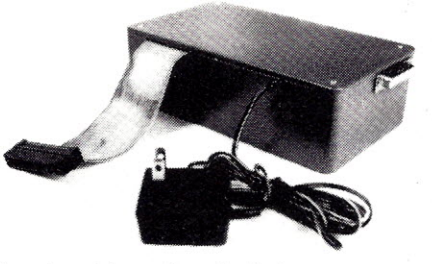

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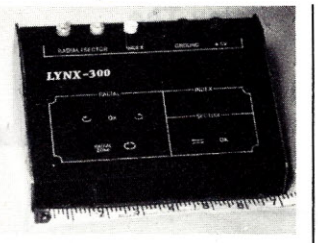
and provide a catalog for exchange of software written by YPLA members. The use of microcomputers in the education of the learning disabled and handicapped will also be encouraged by the exchange of information and software. Annual subscription price for parents, teachers and other grown-up people is $15. Reader Service number 493.

Programmer, a new publication from Media21, offers programming and marketing tips to writers of microcomputer software. It provides information on contracts, agents and royalties, as well as specific help with programming techniques. *Programmer* gives the small, independent software producer a chance to express market needs, and fields as many questions from readers as possible. The newsletter is not currently accepting advertising. Subscription cost is $13 for the first six issues.

Programmer, PO Box 3210, Manchester, NH 03105. Reader Service number 494.

Dual-Processor Micro

North Star's Advantage microcomputer uses two processors: the Z80A as the main CPU and an Intel 8035 as the keyboard and disk controller. The full system has 64K bytes of random-access memory with parity as the main memory, 20K of dedicated random-access memory for the display and a 2K bootstrap programmable read-only memory for the display and floppy disks. The standard screen format is 24 lines by 80 characters, with a graphics resolution of 240 pixels high by 640 pixels wide.



The Lynx-300 disk alignment tool.

The Advantage is supported by one of three different operating systems: the Application Support Program (ASP), Graphics CP/M or North Star's Graphics BASIC/Graphics DOS. Priced under $4000.

North Star Computers, Inc., 14440 Catalina St., San Leandro, CA 94577. Reader Service number 487.

Quick Alignment Tool

The Lynx-300 is a portable, compact and low-cost solution to the problem of verifying and adjusting the alignment of floppy-disk drives. This instrument lets technical support personnel make all the necessary adjustments without the need for an oscilloscope. Any technician can quickly and easily verify and adjust the alignment of any floppy drive encountered. The Lynx-300 uses a series of LEDs to indicate the proper setting for radial and index/sector adjustments. If the proper LED is not illuminated, the drive adjustment is not within specifications. The Lynx is powered by the disk drive being adjusted. It comes with a set of color-coded probes that are attached simultaneously to the drive PCB, reducing the possibility of error in hookup and speed-

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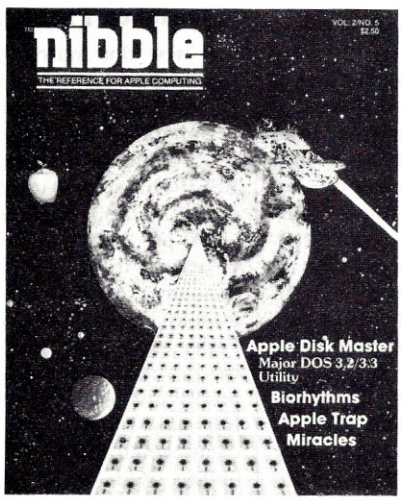

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ing the alignment process. The Lynx-300 comes in a plastic case, priced at $379 U.S., $459 Canadian.

Lynx Design & Technology, Inc., 3880 Chesswood Drive, Downsview, Ontario, Canada M3J 2W6. Reader Service number 491.

Flood Alarm

An electronic protection device that sounds an alarm at the first trace of water in the double floor and other locations in computer rooms is available from KF Industries, Inc., 2310 North American St., Philadelphia, PA 19133. Flood Alarm sounds a loud buzzer when it detects water in unwanted places, so that action can be taken to prevent cable and other damage. The power unit contains the power supply and buzzer assembly, and the two-probe sensor unit contains solid state circuitry. As many sensors as necessary can be added to a single power unit to protect several areas at once. The Model 200 power unit costs $30; each sensor unit is also $30. Reader Service number 499.

Vector Graphic's 3105 computer system in the laboratory.

Industrial and Scientific System

The Vector Graphic 3105 technical computer system includes a Vector 3 Z-80-based processor and terminal, an 18-board card cage for S-100 bus interface cards and a five-inch Winchester disk with five megabytes of storage backed by a single 630K-byte floppy disk. Available peripheral boards include a fast scan video digitizer, a high-resolution graphics module, precision 12-bit digital-to-analog converter, high-speed multichannel ADC, clock/calendar, PROM/RAM board, IEEE-488 interface, relay driver and stepper motor interface board. The system can be tailored for pilot process control, non-destructive and other testing, biophysics, medical electronics, food technology and a wide range of electronics, physics, optical and electromechanical experiments. The basic 3105 system price is $8495.

Vector Graphic, Inc., 500 N. Ventu Park Road, Thousand Oaks, CA 91320. Reader Service number 490.

A Quieter Printer

A new dot matrix printer has been added to the Heath/Zenith line of microcomputer peripherals. The bidirectional H-25 prints 150 cps; all 95 ASCII characters, upper/lowercase, and 33 graphics characters are included. Pitch can be varied from 10–16.5 cpi. Standard edge-punched or fanfold paper feeds easily. Paper exits from the rear of the printer and the cabinet is totally enclosed, thus reducing noise. LEDs light up to indicate when the printer is on, on-line with the computer, out of paper, jammed or has

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HSDS Software $400. (Note: HSDS now also available for CORVUS drives!!)

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Extends Level II BASIC with complete MATRIX functions and 50 more string functions. Includes RACET machine language sorts! Sort 1000 elements in 9 seconds!! Select only functions you want to optimize memory usage.

INFINITE BUSINESS (Requires Infinite BASIC) **Mod I & III $30.00**
Complete printer pagination controls — auto headers, footers, page numbers. Packed decimal arithmetic — 127 digit accuracy +, −, *, /. Binary search of sorted and unsorted arrays. Hash codes.

BASIC CROSS REFERENCE UTILITY (Mod II 64K) **$50.00**
SEEK and FIND functions for Variables, Line Numbers, Strings, Keywords. 'All' options available for line numbers and variables. Load from BASIC — Call with 'CTRL'R. Output to screen or printer!

DSM **Mod I $75.00, Mod II $150.00, Mod III $90.00**
Disk Sort/Merge for RANDOM files. All machine language stand-alone package for sorting speed. Establish sort specification in simple BASIC command File. Execute from DOS. Only operator action to sort is to change diskettes when requested! Handles multiple diskette files! Super fast sort times — improved disk I/O times make this the fastest Disk Sort/Merge available on your TRS.
(Mod I Min 32K 2-drive system. Mod II 64K 1-drive. Mod III 32K 1-drive)

GSF (Mod I & III Tape or Disk - Specify Memory Size)
Mod I $25; Mod II $50; Mod III $30
Generalized Subroutine Facilities. The STANDARD against which all other sorts are compared! And then compare prices! Machine language — fast and powerful! Multi-key multi-variable and multi-key character string. Zero and move arrays. Mod II includes USR PEEKS and POKES. Includes sample programs.

DISCAT (32K 1-drive Min) **Mod I, III $50.00**
This comprehensive Diskette Cataloguing/Indexing utility allows the user to keep track of thousands of programs in a categorized library. Machine language program works with all TRSDOS and NEWDOS versions. Files include program names and extensions, program length, diskette numbers, front and back, and diskette free space.

KFS-80 (1-drive 32K Min — Mod II 64K) **Mod I, III $100.00; Mod II $175.00**
The keyed file system provides keyed and sequential access to multiple files. Provides the programmer with a powerful disk handling facility for development of data base applications. Binary tree index system provides rapid access to file records.

MAILLIST (1-drive 32K Min - Mod II 64K) **Mod I, III $75.00; Mod II $150.00**
This ISAM-based maillist minimizes disk access times. Four keys — no separate sorting. Supports 9-digit zip code and 3-digit state code. Up to 30 attributes. Mask and query selection. Record access times under 4 seconds!!

COMPROC (Mod I & Mod III — Disk only) **Mod I $20; Mod III $30**
Command Processor. Auto your disk to perform any sequence of instructions that you can give from the keyboard. DIR, FREE, pause, wait for user input, BASIC, No. of FILES and MEM SIZE, RUN program, respond to input statements, BREAK, return to DOS, etc. Includes lowercase driver software, debounce and screenprint!

UTILITY PACKAGE (Mod II 64K) **$150.00**
Important enhancements to the Mod II. The file recovery capabilities alone will pay for the package in even one application! Fully documented in 124 page manual! XHIT, XGAT, XCOPY and SUPERZAP are used to reconstruct or recover date from bad diskettes! XCOPY provides multi-file copies, 'Wild-card' mask select, absolute sector mode and other features. SUPERZAP allows examine/change any sector on diskette include track-0, and absolute disk backup/copy with I/O recovery. DCS builds consolidated directories from multiple diskettes into a single display or listing sorted by disk name or file name plus more. Change Disk ID with DISKID. XCREATE preallocates files and sets 'LOF' to end to speed disk accesses. DEBUGII adds single step, trace, subroutine calling, program looping, dynamic disassembly and more!!

DEVELOPMENT PACKAGE (Mod II 64K) **$125.00**
Includes RACET machine language SUPERZAP, Apparat Disassembler, and Model II interface to the Microsoft 'Editor Assembler Plus' software package including uploading services and patches for Disk I/O.

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*TRS-80 IS A REGISTERED TRADEMARK OF TANDY CORPORATION

101

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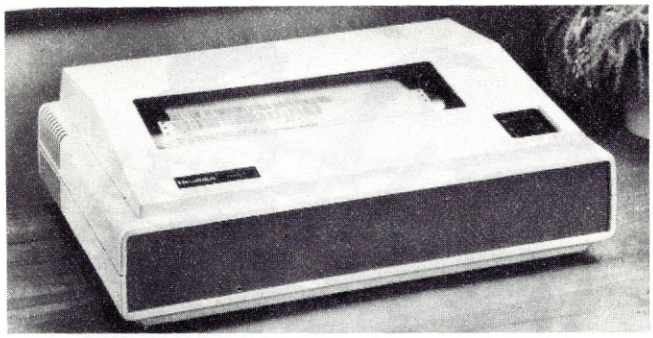

The Heath H-25 dot matrix printer.

the cover open. Automatic test printing and status lights are built in. Price is $1095.

Heath Company, Dept. 350-315, Benton Harbor, MI 49022. Reader Service number 498.

Software-Based Keyboard Design

The Maxi-Switch Universal Keyboard is based on the physical design of one of the first microprocessor-based keyboards, with a standard keyboard typing layout plus numeric blocks at either end. The basic unit is equipped with 103 keyswitch positions, and can be expanded at minimum cost up to 128 positions, using a prepunched panel and a circuit board with traces already in place. Simple preparation of a control EPROM, using existing routines, can equip the board to meet virtually any keyboard specifications. Performance options are selected by keyboard input or jumper and diode options. Price is $210.

Maxi-Switch Co., 9697 E. River Road, Minneapolis, MN 55433. Reader Service number 496.

Single Board for Multi-User Systems

Complete networking capability for S-100 users, including bank-switched memory and parity checking, is available on a single board from MuSYS Corporation, 1451 Irvine Blvd., Suite 11, Tustin, CA 92680. NET/82 features a Z80A CPU, two serial ports, optional floating point processor, interrupt controller, shadow EPROM, real-time clock and S-100 parallel port for communication with the master CPU. NET/82 is compatible with MuDOS, CP/M, MP/M and CP/NET. Parity checking permits easy detection of memory malfunctions. The 128K-byte bank-switched memory option allows the program to select 48–63K of user RAM, controlled through an I/O port. Each serial port can also be customized for other applications, including interface with a serial printer. Price is $1395; $1995 with 128K and floating point processor. Reader Service number 497.

Data Acquisition

The Analog Peripheral is a self-contained eight-bit analog-to-digital converter with its own power supply. Its RS-232C output line is switch selectable from 110 to 9600 bits per second, and can be connected to virtually any computer, from Apple to IBM.

Maxi's Universal Keyboard.

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PACIFIC OFFICE SYSTEMS

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INCOME TAX...

PERSONAL INCOME TAX INTERVIEW PROGRAM written in BASIC by a tax attorney as he would conduct a personal interview to organize taxpayer's data into Federal income tax categories for 1981 tax returns. Program leads the user through an extensive checklist of personal events which can have income tax consequences, giving numerous examples and explanation of tax law for each YES answer.

Covers events such as marriage, divorce, birth, death, employment, lay-offs, retirement, travel, change of residence, accidents, illness or injuries, business ventures, self-employment, education, investments of money or time, prizes, scholarships, insurance recoveries, tax-exempt income, bad debts, etc., as well as the commonly known income items and deductible expenses.

Program also carries out computations for depreciation schedules, joint vs. separate returns, itemized vs. standard deductions, depreciation vs. tax credits, etc., in order to help make important tax decisions. Includes 1981 Tax law changes, references to related areas such as gift and inheritance taxes, trusts, estates, partnerships, corporations, pension and retirement plans, tax-exempt organizations, etc. Includes booklet of useful IRS tax forms, other tax publications, and toll-free phone number of tax attorney. Available on cassette or diskettes for most popular micros. Price $49.95

OTHER POS PRODUCTS . . .
- POS-100 NRZ1 Tape Drive Controller/Formatter $795.00
- POS 800/1600 Universal Tape Drive Controller . . . . $1495.00 (4K/16K buffer, RS-232 or Parallel Ports to CPU)
- POS I/O Conversion Kit for IBM Office Selectric . . . $150.00
- POS ASCII Printer Interface for IBM I/O Selectric . . . $249.95
- POS IBM ASCII Selectric Printer (Parallel Interface) . $895.00
- GTE IS Model 560 ASCII Selectric I/O Terminal $995.00
- POS Daisy-Wheel Printer Interface for TRS-80 Model I . $249.95
- Variable Width FORMS TRACTOR for 15" Selectrics . . $95.00

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See List of Advertisers on page 178

Riverbank Software Inc.
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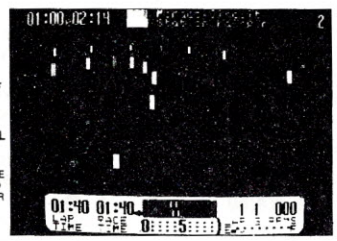
by RICHARD ORBAN
author of THREE MILE ISLAND*



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Five GRAND PRIX-style road circuits, including: Oulton Park, Warwick Farm, Karlskoga, and Monaco ● Five speed manual or automatic transmission (with or without cruise control) ● Eight levels of difficulty.

● ADDITIONAL FEATURES ●

Speeds to 198 MPH ● controlled skids ● spinouts ● spectacular crashes ● hair pin turns ● narrow corners ● obstacles ● identified circuit features ● number of laps selection ● flashing last lap indicator ● 'Christmas tree' controlled start ● switch for silent operation ● blue post marks 300' intervals ● best lap/best race times posted ● fully instrumented control panel: lap timer ● race timer ● indicator lights ● edge detectors ● position indicator ● steering indicator ● moving speed tape ● lap counter ● gear and RPM indicators ● operating fuel gauge

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*TRADEMARK MUSE CO., BALT. MD. ★ ★ APPLE COMPUTER, INC., CUPERTINO, CA.

Special versions for the Apple, Radio Shack, Commodore, Atari, IBM P.C., and other small systems will be available soon.

For immediate notification of availability, please send name, address, and description of system.

See December issue of *Kilobaud* for full page description or send for brochure.

FORTH FOR/MAT™ SCREEN EDITOR

A MUST FOR THE SERIOUS FORTH PROGRAMMER

- All code is Forth-79 standard. Each line of code is fully explained and flowcharted (Forth style) for easy modification.
- This editor works just like the popular word processors on the market except it is written in high level forth and is confined to the 1024 byte boundary of a forth screen.
- There are over 20 different commands for cursor positioning, text modification, tabs, relocating lines, spreading lines, and moving lines to other screens.
- Insert mode is toggled on and off for midstream insertions and deletions. Text ahead of CP is moved right during insertion and left during deletion if insert mode is on.
- Column position is displayed at all times.
- Bomb proof — all unused control codes are trapped.
- Must be used with a CRT that has cursor addressing or with a memory mapped video.
- Send check or money order in the amount of $50.00 and receive complete source code, flowcharts, documentation, and instructions for bringing up on your system.

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TUCSON, AZ 85726
(602) 889-5722

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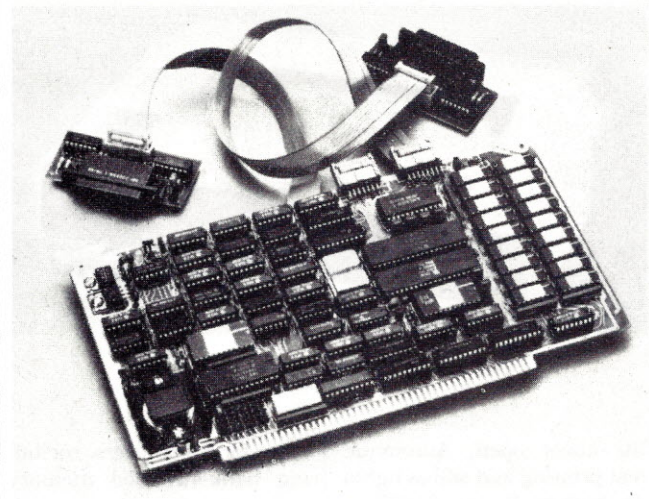
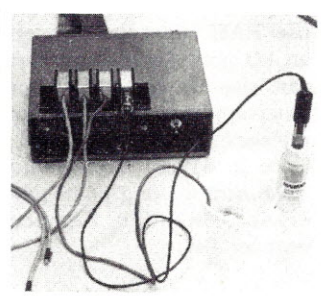


The NET/82 single board computer from MuSYS Corporation.

There is also a 26-pin parallel output for faster data transfer rates. Plug-in sensors for temperature, light, pH and other analog signals eliminate the need for building transducer circuits. Four input channels permit logging of several variables at once. Fast conversion speed of 100 μs is sufficient for most teaching applications.

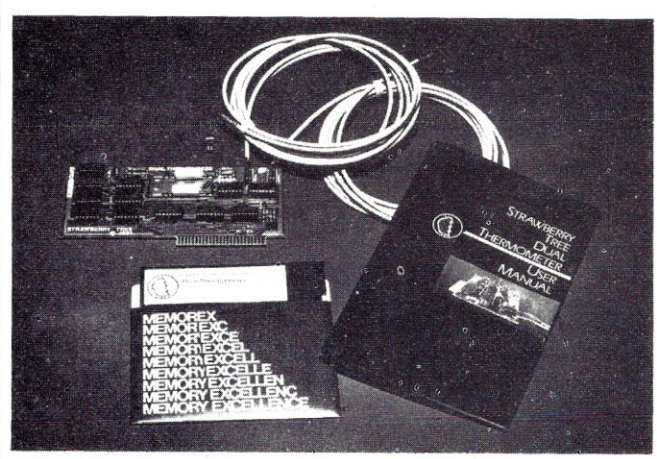
Cambridge Development Laboratory, 36 Pleasant St., Watertown, MA 02172. Reader Service number 495.



The Analog Peripheral from Cambridge Development Laboratory.

Dual Thermometer For Apple II

Strawberry Tree Computers, 949 Cascade Drive, Sunnyvale, CA 94087, is offering an Apple II interface card with two complete thermometers and software. The system turns an Apple into a laboratory tool that measures, logs and analyzes temperature. It will display time, temperature, maximum and minimum temperatures and temperature difference between probes. An alarm will sound at any preset temperature. Just plug in the two ten-foot probes to measure temperatures from −55 to 125 degrees Celsius. The Dual Thermometer package costs $260. Reader Service number 489.



This Dual Thermometer package from Strawberry Tree Computers converts an Apple II into a precision measurement tool.

OSI TRS-80 COLOR-80 OSI

GALAXIAN - 4K - One of the fastest and finest arcade games ever written for the OSI, this one features rows of hard-hitting evasive dogfighting aliens thirsty for your blood. For those who loved (and tired of) Alien Invaders. Specify system — A bargain at $9.95 OSI

LABYRINTH - 8K - This has a display background similar to MINOS as the action takes place in a realistic maze seen from ground level. This is, however, a real time monster hunt as you track down and shoot mobile monsters on foot. Checking out and testing this one was the most fun I've had in years! — $13.95. OSI

THE AARDVARK JOURNAL

FOR OSI USERS — This is a bi-monthly tutorial journal running only articles about OSI systems. Every issue contains programs customized for OSI, tutorials on how to use and modify the system, and reviews of OSI related products. In the last two years we have run articles like these!

1) A tutorial on Machine Code for BASIC programmers.
2) Complete listings of two word processors for BASIC IN ROM machines.
3) Moving the Directory off track 12.
4) Listings for 20 game programs for the OSI.
5) How to write high speed BASIC — and lots more —

Vol. 1 (1980) 6 back issues - $9.00
Vol. 2 (1981) 4 back issues and subscription for 2 additional issues - $9.00.

ADVENTURES!!!

For OSI, TRS-80, and COLOR-80. These Adventures are written in BASIC, are full featured, fast action, full plotted adventures that take 30-50 hours to play. (Adventures are interactive fantasies. It's like reading a book except that you are the main character as you give the computer commands like "Look in the Coffin" and "Light the torch".)

Adventures require 8K on an OSI and 16K on COLOR-80 and TRS-80. They sell for $14.95 each.

ESCAPE FROM MARS (by Rodger Olsen)
This ADVENTURE takes place on the RED PLANT. You'll have to explore a Martian city and deal with possibly hostile aliens to survive this one. A good first adventure.

PYRAMID (by Rodger Olsen)
This is our most challenging ADVENTURE. It is a treasure hunt in a pyramid full of problems. Exciting and tough!

TREK ADVENTURE (by Bob Retelle)
This one takes place aboard a familiar starship. The crew has left for good reasons - but they forgot to take you, and now you are in deep trouble.

DEATH SHIP (by Rodger Olsen)
Our first and original ADVENTURE, this one takes place aboard a cruise ship - but it ain't the Love Boat.

VAMPIRE CASTLE (by Mike Bassman)
This is a contest between you and old Drac - and it's getting a little dark outside. $14.95 each.

OSI NEW-NEW-NEW TINY COMPILER OSI

The easy way to speed in your programs. The tiny compiler lets you write and debug your program in Basic and then automatically compiles a Machine Code version that runs from 50-150 times faster. The tiny compiler generates relocatable, native, transportable machine code that can be run on any 6502 system.

It does have some limitations. It is memory hungry — 8K is the minimum sized system that can run the Compiler. It also handles only a limited subset of Basic — about 20 keywords including FOR, NEXT, IF THEN, GOSUB, GOTO, RETURN, END, STOP, USR(X), PEEK, POKE, -, =, *, /, , <,> , Variable names A-Z, and Integer Numbers from 0-64K.

TINY COMPILER is written in Basic. It can be modified and augmented by the user. It comes with a 20 page manual.
TINY COMPILER — $19.95 on tape or disk OSI

SUPERDISK II

This disk contains a new BEXEC* that boots up with a numbered directory and which allows creation, deletion and renaming of files without calling other programs. It also contains a slight modification to BASIC to allow 14 character file names.

The disk contains a disk manager that contains a disk packer, a hex/dec calculator and several other utilities.

It also has a full screen editor (in machine code on C2P/C4)) that makes corrections a snap. We'll also toss in renumbering and program search programs — and sell the whole thing for —
SUPERDISK II $29.95 (5¼") OSI

BARE BOARDS FOR OSI C1P

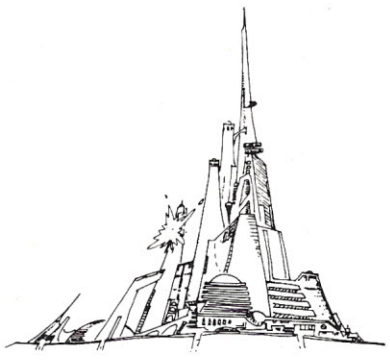
MEMORY BOARDS!!! — for the C1P — and they contain parallel ports!

Aardvarks new memory board supports 8K of 2114's and has provision for a PIA to give a parallel ports! It sells as a bare board for $29.95. When assembled, the board plugs into the expansion connector on the 600 board. Available now!

PROM BURNER FOR THE C1P — Burns single supply 2716's. Bare board — $24.95.

MOTHER BOARD — Expand your expansion connector from one to five connectors or use it to adapt our C1P boards to your C4/8P. - $14.95.

16K RAM BOARD FOR C1P — This one does not have a parallel port, but it does support 16K of 2114's. Bare Board $39.95.



WORD PROCESSING THE EASY WAY— WITH MAXI-PROS

This is a line-oriented word processor designed for the office that doesn't want to send every new girl out for training in how to type a letter.

It has automatic right and left margin justification and lets you vary the width and margins during printing. It has automatic pagination and automatic page numbering. It will print any text single, double or triple spaced and has text centering commands. It will make any number of multiple copies or chain files together to print an entire disk of data at one time.

MAXI-PROS has both global and line edit capability and the polled keyboard versions contain a corrected keyboard routine that make the OSI keyboard decode as a standard typewriter keyboard.

MAXI-PROS also has sophisticated file capabibilities. It can access a file for names and addresses, stop for inputs, and print form letters. It has file merging capabilities so that it can store and combine paragraphs and pages in any order.

Best of all, it is in BASIC (OS65D 51/4" or 8" disk) so that it can be easily adapted to any printer or printing job and so that it can be sold for a measly price.
MAXI-PROS — $39.95. Specify 5¼ or 8" disk.

SUPPORT ROMS FOR BASIC IN ROM MACHINES — C1S/C2S. This ROM adds line edit functions, software selectable scroll windows, bell support, choice of OSI or standard keyboard routines, two callable screen clears, and software support for 32-64 characters per line video. Has one character command to switch model 2 C1P from 24 to 48 character line. When installed in C2 or C4 (C2S) requires installation of additional chip. C1P requires only a jumper change. — $39.95
C1E/C2E similar to above but with extended machine code monitor. — $59.95 OSI

ARCADE GAMES FOR OSI, COLOR-80 AND TRS-80 (8K OSI, 16K TRS-80 AND COLOR-80)

TIMETREK - A REAL TIME, REAL GRAPHICS STARTRECK. See your torpedoes hit and watch your instruments work in real time. No more unrealistic scrolling displays! $14.95.

STARFIGHTER - This one man space war game pits you against spacecruisers, battlewagons, and one man fighters, you have the view from your cockpit window, a real time working instrument panel, and your wits. Another real time goody. $9.95

BATTLEFLEET - This grown up version of Battleship is the toughest thinking game available on OSI or 80 computers. There is no luck involved as you seek out the computers hidden fleet. A topographical toughie. $9.95

QUEST - A NEW IDEA IN ADVENTURE GAMES! Different from all the others, Quest is played on a computer generated mape of Alesia. Your job is to gather men and supplies by combbat, bargaining, exploration of ruins and temples and outright banditry. When your force is strong enough, you attack the Citadel of Moorlock in a life or death battle to the finish. Playable in 2 to 5 hours, this one is different every time.
16K COLOR-80 OR TRS-80 ONLY. $14.95

Please specify system on all orders

This is only a partial listing of what we have to offer. We offer over 120 games, ROMS, and data sheets for OSI systems and many games and utilities for COLOR-80 and TRS-80. Send $1.00 for our catalog.

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COLOR-80

↙See List of Advertisers on page 178

NEW SOFTWARE

Edited by Linda Stephenson

Byte Your Way to Good Nutrition
Apple Statistics
Make Music with VIC
Understanding Asian Languages

Diet Analysis

Nutri-Calc is a nutritional analysis program designed to rapidly and accurately assess individual nutrient intake. Eighteen of the nutrients found in 730 common foods are included. Nutrient values have been taken from standard USDA listings. The user can modify the food and nutrient database as needed. Comparisons of input data to the recommended daily allowances for specific subgroups is provided; calculations are based on age and sex, and for infants, body weight. Nutri-Calc lets the user build new food items (over 200) by combining components already in the foods database. Standard menus and special recipes can also be stored. The program can be used with Apple II+, TRS-80 Models II and III, and any CP/M or UCSD p-System microcomputers with 64K-byte memory and eight-inch single-density disk drives. Price is $350.

PCD Systems, Inc., PO Box 143, Penn Yan, NY 14527. Reader Service number 464.

Statistics For the Apple

Rainbow Computing, 19517 Business Center Dr., Northridge, CA 91324, offers a comprehensive statistics package for the Apple II with Applesoft and DOS 3.3. Statistics with Daisy offers a full range of statistical capabilities for business, scientific and social science applications. It features Help and Info functions to simplify operation. The system does math and time-series transforms, hi-resolution plots, basic statistics, correlations, multiple regression (six different procedures), model testing and evaluation, nonparametric statistics, hypothesis testing and analysis of variance. Users can add their own programs as new Daisy commands. Data is entered through a window view into the data table. Statistics with Daisy is priced at $79.95. Reader Service number 465.

Music Composer

Turn your VIC microcomputer into a music machine with VIC Piper. This program lets you compose, save, recall and play back music, using a standard VIC without additional hardware. You enter notes by using alpha notation: A, F#, C, G, D; rests and note duration are also entered at the keyboard. You can vary the volume and tempo, play harmony, print pictures of text to accompany your music and automatically load and run additional compositions from cassette or disk. Price is $25, including manual and sample compositions.

Abacus Software, PO Box 7211, Grand Rapids, MI 49510. Reader Service number 466.

Professional Tax Preparation

The Income Tax Preparation system by Micro-Tax, Microcomputer Taxsystems, Inc., 22713 Ventura Blvd., Suite F, Woodland Hills, CA 91364, is designed to computerize the tax professional's office. The system accepts the data, summarizes needed information, computes tax and prints the required IRS and state forms. The tax specialist can provide clients with immediate results. Micro-Tax offers the system in three levels, priced from $250–$1000. Reader Service number 467.

Asian Languages Program

Asiagraphics software enables people using Asian languages, with their many thousands of ideographic characters, to use computer technology for word processing, data processing, telex and other applications. A specific character is selected by typing a unique code (descriptor) on a standard keyboard; the character is displayed on the video screen. Both traditional and simplified characters are available. The descriptor consists of the phonetic representation of the character's pronunciation and a phonetic rendering of the radical family to which the character belongs. The operator must be literate in the language used and know the phonetic system on which the descriptors are based. Using touch typing, speeds comparable to western language typing speeds can be achieved. Descriptors for more than 6600 charactors currently exist in memory; new characters can be entered at any time by drawing the needed character on a grid with the character generator program.

China Institute in America, Inc., 125 East 65th St., New York, NY 10021. Reader Service number 469.

Spelling Help for Your 6809

A misspelled word that slips by your secretary but is noticed by a potential customer will cost you sales; spelling errors in a manuscript almost guarantee a rejection slip. Spell-Test will help you find those deadly spelling errors. Spell-Test, for Flex-based 6809 microcomputers, is completely menu-driven. The program stops and points to all invalid words, so you can Accept the word as it is, Accept and Save it for use in an optional dictionary later or Replace it. You can do a quick check of your prose with the basic 11,000-word dictionary or a thorough check against a comprehensive 21,000-word dictionary. Spell-Test on a standard Flex disk costs $195.

Frank Hogg Laboratory, 130 Midtown Plaza, 700 East

謹订于十月二十三日，星期五，上午十一时假华美协进社二楼图书室举行中文电脑打字程式系统示范表演，届时恭请光临。

华美协进社謹订

The China Institute in America has introduced the Asiagraphics Software System.

Water St., Syracuse, NY 13210. Reader Service number 471.

Computerized Ratings

Media Service Concepts, 1713 N. North Park Ave., Chicago, IL 60614, has introduced Recall, a radio ratings analysis package for use on the Apple II. Recall lets a radio station quickly organize and interpret data furnished by Arbitron, the major radio ratings service. Recall can analyze up to four radio stations or four rating books simultaneously. The different sections provide in-depth understanding of radio audience flow dynamics and market positioning. Recall can help a radio station find its strengths and weaknesses, and those of competitors. Recall is priced at $750. Reader Service number 468.

Apple Graphics

The Superplotter is a professionally-oriented graphics package for business, engineering, education and math applications. The program features pie graphs, standard bar charts, point and line graphs, a mathematical function plotter, a least squares polynomial curve-fit generator, automatic graphics disk storage and recall, a data file editor, overlay modes, a user tutorial and keyboard image shapes that can be mixed with the user's own graphics displays. The program runs on Apple computers with Applesoft. Price is $59.95.

Dickens Data Systems, 433 Greenwood Drive, LaPlace, LA 70068. Reader Service number 472.

Econometric Software

WITS World Information and Technology Systems Corp., 235 Yorkland Blvd., Suite 901, Willowdale, Ontario M2J 4W9, has announced WITS/Economist, a software package that helps businesspeople develop financial and marketing strategies. WITS/Economist is used for profitability and break-even analysis; capital budgeting, investment, pricing and marketing/advertising decisions; and competitive and risk analysis. To model a business the user types in the key business parameters that describe anticipated economic, financial and marketing conditions. WITS/Economist presents the resulting business scenario and guides the user interactively through price-sale optimization and risk analysis. WITS/Economist is available on Heath/Zenith systems under CP/M and HDOS. It requires 48K bytes of memory and one disk drive. Price is $495 (Canadian). Reader Service number 470.

Hi-Res Graphics For Atari

Versa Computing, Inc., 3541 Old Conejo Road, Suite 104, Newbury Park, CA 91320, has a complete joystick/paddle graphics software package for 32K Atari 400/800 computers. With Graphics Composer you can use paddles or joystick to draw a picture outline on hires screen Mode 8 or 7. Then use color fill-in, color brushes and Add Text to complete your graphics designs. Graphics Composer lets you create player/missile shapes to use in other programs. The geometric figures program lets you define circles, triangles, polygons, parallelograms and even trigonometric curves. Loading routines are provided so that pictures can be used in other programs or traded with friends. Price is $39.95, on disk or cassette. Reader Service number 474.

Two Investment Broker Systems

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vi$or is a stocks and bonds portfolio management system featuring immediate access to all options, stocks, bonds and commodities held, and detailed information about each. Both programs have access to four on-line quote services, with software to automatically update. The Analy$t is $425; Advi$or is $375; the price for both is $750. Add $95 for CP/M versions.

Kate's Komputers, PO Box 1675, Sausalito, CA 94965. Reader Service number 475.

Multi-Tasking Kernel

The Multi-Tasking Kernel from U.S. Software, 5470 NW Innisbrook Place, Portland, OR 97229, is a tool for integrating multiple real-time software tasks. It is burned into read-only memory, and oversees the selection and execution of each task. The kernel is small, fast and easy to use. The Multi-Tasking Kernel is documented, tested and available in source assembly form for the 8085, Z-80, 6502, 6800 and 6809 microprocessors. The package provides source code for a basic multitasking organization (tasks self-schedule in a round-robin ordering). The user is guided through a series of enhancements for implementing sophisticated interrupt-initiated, preemptive priority, dynamic task scheduling. Also included are descriptions of dedicated and shared-resource scheduling, time-slice scheduling and intertask communication schemes. Price is $195 for full internal use rights and unlimited rights to distribute kernel-based products in machine form. Reader Service number 476.

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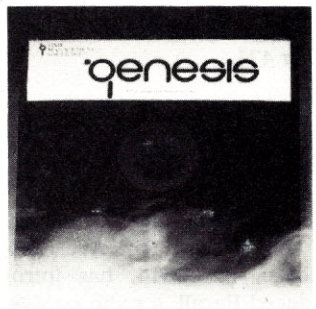
Level 10 offers a $5000 reward for the return of the Alkemstone. Their new computer adventure challenges you to recover the missing Alkemstone from the underground lair in which it has been concealed. Unusual messages, fragments of words, sketches and other clues written on the cave walls will lead you to the treasure. And the first player to describe its exact location to Level 10's designated judge wins $5000. The game features hi-resolution graphics, three-dimensional animation, sound effects and an illustrated short story. It runs on an Apple with 48K and one 16-sector disk drive.

Level 10 Division, Dakin5 Corp., 7475 Dakin St., Suite 507, Denver, CO 80221. Reader Service number 477.

Software Development

Genesis is a professional program generator that accepts commands in conversational English, has ample memory capacity to code difficult algorithms and generates efficient code faster than four lines per second. Genesis runs on all CP/M 2.XX systems and uses compiled PL/1-80, although PL/1-80 is not required to run the program. Code is generated in CBASIC. The program comes with on-line documentation and a complete manual. Price is $500.



Genesis program generator from Time Management Software.

Time Management Software, 123 E. Broadway, PO Box 727, Cushing, OK 74023. Reader Service number 478.

Language Hybrid

Starside Engineering, PO Box 8306, Rochester, NY 14618, offers the RUNIC 1.0 threaded interpreted language, on CP/M disk, in various popular microcomputer formats. RUNIC has its roots

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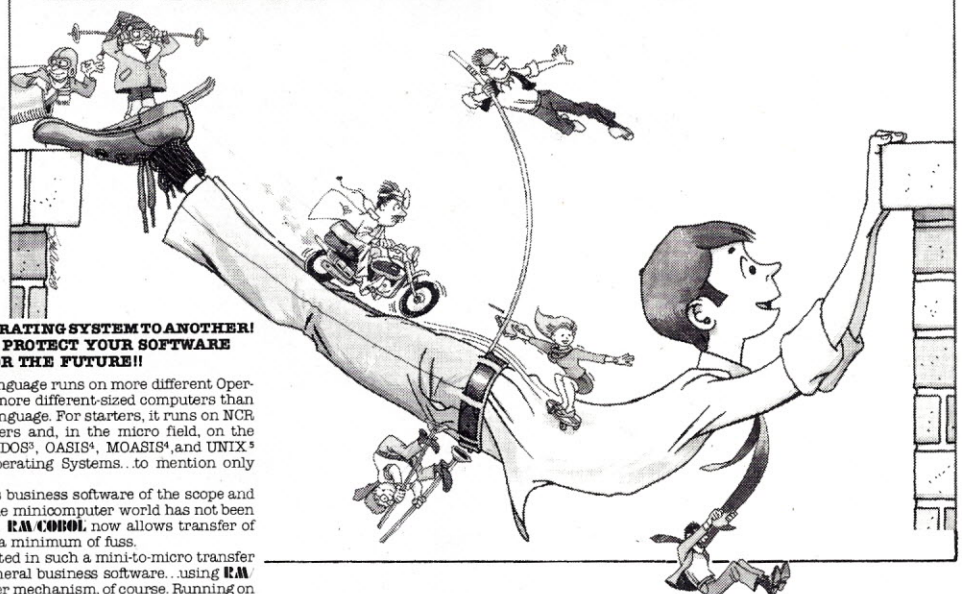

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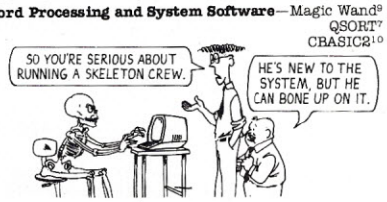

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in FORTH, but is more easily read and maintained than FORTH code. RUNIC implements higher-level data structures than FORTH, including integers, floats and character strings. RUNIC uses RPN to evaluate its expressions, but its control structures are closer to those of Pascal, BASIC and other algebraic languages. Price is $52.95. Reader Service number 479.

VisiPeek

Micro-Sparc, Box 325, Lincoln, MA 01773, has released a utility for users of Personal Software's VisiCalc on the Apple II. Apple VIP (VisiCalc Info Printer) reads VisiCalc files and produces listings of the formats, formulas, variables and other VisiCalc grid elements. Labels and formulas appear in their complete, untruncated form. VIP lets you examine individual elements, selected areas of the grid or the entire VisiCalc sheet. Files can be listed in either row or column sequence, sorted alphabetically by column. Apple VIP requires Applesoft; specify DOS 3.2 or 3.3 version. Price is $23.45. Reader Service number 480.

Space Waste Race

Storybooks of the Future, 527-41st Ave., San Francisco, CA 94121, has announced Space Waste Race, a computerized storybook for young children. This program for the TRS-80 includes animated graphics, music, sound effects and contextual learning activities. The learning games involve the story's graphics or ideas. The story tells about the moon getting jealous when a giant rocket ship brings all the earth's wastes into space to form a new garbage "moon." A silly moon race ensues that ends in collision—and the fallout can go either way. Space Waste Race is available on cassette or disk for Models I and III. The 32K program costs $24.95; the slimmer 16K version (storybook with three games only) is $19.95. Reader Service number 481.

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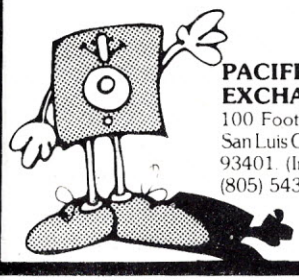

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CONVERSIONS "I"

Fifteen Puzzle

This program is a conversion of William L. Colsher's Fifteen Puzzle (*Kilobaud Microcomputing*, February 1981, p. 114) from TRS-80 Level I to Level II. It is contributed by E. L. Green, 890 Montego Bay Drive, Merritt Island, FL 32952.

Kilobaud Microcomputing welcomes and encourages such conversions of programs that appear in the magazine.

Program listing.

```
5       REM*** FIFTEEN PUZZLE FROM MICROCOMPUTING FEB 81 PG 114
10      REM*** BY WILLIAM L.COLSHER - LISLE, ILL 60532
20      REM*** MODIFIED BY E.L.'LANK'GREEN - 890 MONTEGO BAY DR.                M
ERRITT ISLAND,FL 32952 - TO RUN AS A LEVEL II                    PROGRAM FOR TRS 8
0.
25 DIMA(16)
30 CLS:INPUT"DO YOU NEED INSTRUCTIONS (Y=1, N=2)";A:IF A=1 THEN GOSUB 10000
40 CLS:M=0:PRINT"GENERATING THE PUZZLE TAKES A WHILE. PLEASE WAIT."
50 FOR I=1 TO 16: A(I)=0:NEXT I
60 FOR I=1 TO 16
70 R=RND(16)
80 IF A(R)<>0 THEN 70
90 A(R)=I
100 NEXT I
110 GOSUB 5000
120 IF F=1 THEN 50
130 GOSUB 6000
140 PRINT" ":INPUT"YOUR MOVE";X
145 GOSUB 4000
150 GOSUB 7000
160 IF F<>0 THEN 180
170 PRINT"ILLEGAL MOVE, RE-ENTER": FOR I=1 TO 500:NEXTI:GOTO130
180 A(X+F)=A(X):A(X)=16
190 GOTO 8000
200 M=M+1: GOTO 130
999 END
4000    REM*** CONVERT NUMBER TO LOCATION IN ARRAY
4010 FOR I=1 TO 16
4020 IF A(I)=X THEN 4040
4030 NEXT I
4040 X=I
4050 RETURN
5000    REM*** VERIFY SOLUTION POSSIBLE
5005 F=1
5010 S=0
5020 FOR I=1 TO 15
5030 FOR J=I+1 TO 16
5040 IF A(I)>A(J) THEN S=S+1
5050 NEXT J: NEXT I
5060 FOR I=1 TO 8
5070 READ X
5080 IF A(X)=0 THEN S=S+1
5090 NEXT I
5095 RESTORE
5100 A=INT(S/2)
5110 IF A*2=S THEN F=0
5120 RETURN
5130 DATA 2, 4, 5, 7, 10, 12, 13, 15
6000    REM*** DISPLAY GAME BOARD
6005 CLS: L=339:PRINT@217,"MOVE  ";M
6010 FOR I=1 TO 4
6015 PRINT@L," ";
6020 FOR J=1 TO 4
6025 N=A((I-1)*4+J)
6028 IF N=16 THEN N=0
6030 IF N<10 THENPRINT" ";N;:GOTO 6040
6038 IF (N=10)OR(N<16) THEN PRINTN;
6040 NEXTJ
6050 L=L+64
6060 NEXT I
6070 RETURN
7000    REM*** CHECK FOR LEGAL MOVE
7010 F=0
7015 IF X+1>16 THEN 7025
7020 IF A(X+1)=16 THEN F=1
7025 IF X-1<=0 THEN 7035
7030 IF A(X-1)=16 THEN F=-1
7035 IF X+4>16 THEN 7045
7040 IF A(X+4)=16 THEN F=4
7045 IF X-4<=0 THEN 7060
7050 IF A(X-4)=16 THEN F=-4
7060 RETURN
8000    REM*** CHECK FOR A WIN
8010 FOR I=1 TO 16
8020 IF A(I)<> I THEN200
8030 NEXT I
8040 GOSUB 6000
8050 PRINT"  ":PRINT"  "
8060 PRINT"CONGRATULATIONS!!! YOU DID IT IN ONLY";M;"MOVES!!"
8070 PRINT" ":INPUT"TO PLAY AGAIN, HIT 'ENTER'.";A$
8080 GOTO 10
```

More →

Listing continued.

```
10000  REM*** INSTRUCTIONS
10010 CLS:PRINT@18,"F I F T E E N  P U Z Z L E"
10020 PRINT@128,"THE OBJECT OF THE FIFTEEN PUZZLE IS TO MOVE THE"
10030 PRINT"NUMBERS AROUND SO THAT THEY ARE IN ORDER FROM 1 TO 15."
10040 PRINT"A MOVE IS MADE BY TYPING IN THE NUMBER (WHICH MUST BE "
10050 PRINT"ADJACENT TO THE ZERO) YOU WISH TO MOVE. THAT NUMBER IS"
10060 PRINT"THEN EXCHANGED WITH THE ZERO. YOU WIN WHEN THE BOARD"
10065 PRINT"LOOKS LIKE THIS:"
10070 PRINT" ":PRINT" ":PRINT"1  2  3  4":PRINT"5  6  7  8":PRINT"9 10 11 12"
10080 PRINT"13 14 15 0"
10090 PRINT" ": INPUT"HIT 'ENTER' TO PLAY";A$
10100 RETURN
```

CONVERSIONS "II"

A "Personable" Calendar

This conversion of G.R. Boynton's Personable Calendar program for the PET (Aug. 1980, p. 168) is written in Applesoft BASIC. The author has added one-key inputs and a printer prompt for a printed calendar of appointments. The printed sheet can list for a specific day or for a full month. To print out a monthly calendar when prompted to enter the date, simply enter the month only. (Contributed by Kenneth M. Jenkins, 915 S. 12th St., Gadsden, AL 35901.)

Program listing.

```
5  HOME : VTAB 5
10  PRINT "PLEASE TYPE IN YOUR GREETING !>>>>"
20  VTAB 20
21  INPUT "HERE >>:";G$
30  FOR I = 1 TO  LEN (G$)
40  IF  MID$ (G$,I, LEN ("KEN")) = "KEN" THEN NA$ = "KEN"
50  NEXT I
60  IF NA$ = "KEN" THEN  GOTO 1010
70  HOME : INPUT "MY NAME IS 'ISAAC', WHAT IS YOUR NAME? ";NA$
90  GOSUB 1110
92  PRINT
95  HOME : VTAB 12
97  PRINT "ENTER DATE AS (EX. AUGUST 01)": PRINT
100  INPUT "WHAT IS THE DATE TODAY? ";D$
120  GOTO 2010
890  HOME
900  PRINT "THE PROGRAM IS MADE UP OF THE FOLLOWING"
902  PRINT "COMPONENTS:"
903  PRINT : PRINT : PRINT
904  PRINT  TAB( 5)"1 - CONTROL FOR HELLO"
906  PRINT  TAB( 5)"10-120"
908  PRINT  TAB( 5)"2 - GREETINGS KEN"
910  PRINT  TAB( 5)"1000-1099"
912  PRINT  TAB( 5)"3 - GREETINGS OTHER"
914  PRINT  TAB( 5)"1100-1199"
916  PRINT  TAB( 5)"4 - READ DATA FOR CALENDAR"
918  PRINT  TAB( 5)"2000-2140"
920  PRINT  TAB( 5)"5 - ROUTE FOR CALANDAR SUBR'S"
922  PRINT  TAB( 5)"2145-2299"
924  PRINT  TAB( 5)"6 - TODAY'S EVENTS"
926  PRINT  TAB( 5)"2300-2330"
928  PRINT : PRINT "HIT 'RETURN' TO GET THE REST"
930  GET A$: HOME : IF A$ = "" THEN 930
932  VTAB 10
936  PRINT  TAB( 5)"7 - OTHER DATES"
938  PRINT  TAB( 5)"2400-2450"
940  PRINT  TAB( 5)"8 - UNFINISHED ITEMS"
942  PRINT  TAB( 5)"2500-2599"
944  PRINT  TAB( 5)"9 - CHANGE STATUS OF ITEMS"
946  PRINT  TAB( 5)"2600-2699"
948  PRINT  TAB( 5)"10- ADD ITEMS TO CALENDAR"
950  PRINT  TAB( 5)"2700-2799"
956  PRINT  TAB( 5)"11- WRITE TO DISK"
958  PRINT  TAB( 5)"2800-2898"
960  PRINT  TAB( 5)"12- SEARCH BY DATE"
962  PRINT  TAB( 5)"2900-2999"
968  PRINT : PRINT "HIT 'RETURN' FOR  CALENDAR "
970  GET A$: HOME : IF A$ = "" THEN 970
979  GOTO 2190
980  IF  FRE (0) > 200 THEN 987
981  HOME
982  VTAB 12: PRINT "THERE IS VERY LITTLE SPACE LEFT IN MEMORY"
983  PRINT : INPUT "DO YOU WANT TO DELETE ALL OF THE ITEMS THAT ARE FINIS
     HED?";A$
```

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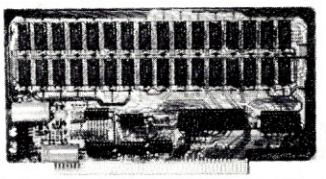

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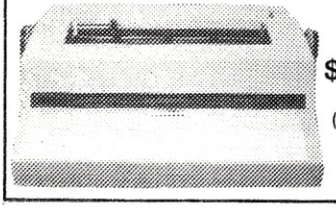

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Listing continued.

```
985  IF A$ = "Y" THEN E = 1: GOSUB 2510
986  GOTO 996
987  HOME : IF CH < = WR THEN 995
988  VTAB 12: PRINT "THERE ARE ONE OR MORE CHANGES THAT HAVE NOT BEEN REC
     ORDED."
989  INPUT "DO YOU WANT TO WRITE THEM TO DISK?";A$
990  IF A$ = "Y" THEN  GOSUB 2810
995  HOME
996  VTAB 12: PRINT  TAB( 20)"GOODBYE!"" "NA$
998  PRINT  TAB( 20)"GLAD I COULD HELP YOU."
999  FOR I = 1 TO 3000: NEXT I: HOME : PRINT  CHR$ (4);"RUN DISK $21"
1000  REM  HELLO KEN
1010  LET N =  INT (( RND (1) * 10) / 2.5) + 1
1020  ON N GOSUB 1035,1045,1055,1065
1025  FOR K = 1 TO 1500: NEXT K
1030  GOTO 92
1035  HOME : VTAB 12: HTAB 30
1040  PRINT "HELLO DESIGNER": RETURN
1045  HOME : VTAB 12: HTAB 30
1050  PRINT "BACK TO WORK, EH?": RETURN
1055  HOME : VTAB 12: HTAB 30
1060  PRINT "HI, KEN": RETURN
1065  HOME : VTAB 12: HTAB 30
1070  PRINT "HOWDY, KEN": RETURN
1100  REM  OTHERS
1110  HOME : VTAB 12: PRINT NA$" ..I AM A CALENDAR OF THINGS"
1120  PRINT "TO BE DONE."
1130  PRINT "I HELP KEN KEEP UP WITH HIS WORK."
1135  FOR K = 1 TO 1500: NEXT K
1140  PRINT "HE TELLS ME WHAT HE HAS TO DO ON EACH"
1150  PRINT "DAY, AND I REMIND HIM ABOUT WHAT IS ON"
1160  PRINT "FOR TODAY, AND WHAT HE HAS NOT FINISHED."
1170  FOR K = 1 TO 6500: NEXT
1180  RETURN
2000  REM  CALENDAR ROUTINE
2005  FOR I = 1 TO 2000: NEXT I
2010  HOME : VTAB 12
2015  PRINT "FIRST I HAVE TO READ THE CALENDAR---"NA$
2016  PRINT
2017  HTAB 25
2020  PRINT "CAN YOU WAIT? ";: GET A$
2021  HOME
2023  IF A$ = "Y" THEN  GOTO 2045
2025  HOME : VTAB 12
2040  IF  LEFT$ (A$,1) <  > "Y" THEN  PRINT "NOTHING HAPPENS "NA$" WITHOU
     T READING THE DISK-FILE FIRST !": GOTO 2000
2045  HOME : VTAB 12
2050 L = 1:D = 1:C = 0:F$ = "MEMOS"
2060  PRINT  CHR$ (4);"OPEN ";F$
2065  PRINT  CHR$ (4);"READ ";F$
2070  INPUT N
2080 J = N + 10
2090  DIM DA$(J),IT$(J),ST$(J)
2100  FOR K = 1 TO N
2110 : INPUT DA$(K),IT$(K),ST$(K)
2130  NEXT K
2140  PRINT  CHR$ (4);"CLOSE ";F$
2150  HOME : VTAB 12
2155  PRINT "WOULD YOU LIKE TO SEE WHAT IS ON FOR ";
2160  PRINT "TODAY? ";: GET A$
2165  HOME : VTAB 12
2180  IF A$ = "Y" THEN  GOSUB 2310
2190  PRINT "WHAT'S NEXT ";NA$"? (TYPE FIRST WORD OF SELECTION)."
2195  PRINT : PRINT
2200  PRINT  TAB( 10)"OTHER DATES"
2210  PRINT  TAB( 10)"PAST ITEMS NOT COMPLETE"
2220  PRINT  TAB( 10)"STATUS UPDATE"
2230  PRINT  TAB( 10)"ADDITIONS"
2240  PRINT  TAB( 10)"TODAY"
2245  PRINT  TAB( 10)"COMPONENTS OF PROGRAM"
2250  PRINT  TAB( 10)"DONE WITH CALENDAR"
2252  PRINT : PRINT : PRINT "WHICH? >>:";: GET A$
2260  IF A$ = "O" THEN RO = 1
2265  IF A$ = "P" THEN RO = 2: REM   2510
2270  IF A$ = "S" THEN RO = 3: REM   2605
2275  IF A$ = "A" THEN RO = 4: REM   2705
2280  IF A$ = "T" THEN RO = 5: REM   2310
2283  IF A$ = "C" THEN  GOSUB 890
2285  IF A$ = "D" THEN 980
2290  ON RO GOSUB 2400,2500,2600,2700,2300,900
2295  GOTO 2190
2300  REM  TODAY
2310 SE$ = D$
2320  GOSUB 2900
2330  RETURN
2400  HOME : VTAB 12
2402  PRINT "FOR SPECIFIC DATE..TYPE MONTH & DAY (EX.JUNE 23)"
2404  PRINT "FOR FULL MONTH'S SCHEDULE..TYPE MONTH ONLY (EX.JUNE)": PRINT

2410  INPUT "WHICH DATE ARE YOU LOOKING FOR?";DB$
2430  HOME :SE$ = DB$
2440  GOSUB 2900
2450  RETURN
2500  HOME : VTAB 12
2510  PRINT "HERE IS WHAT'S HANGING OVER YOUR HEAD!"
2515  PRINT
2520  FOR K = 1 TO N
2525  IF E = 1 AND ST$(K) = "NOT FINISHED" THEN NN = NN + 1
```

More

Listing continued.

```
2530  IF ST$(K) = "FINISHED" THEN  GOTO 2540
2535  IF ST$(K) = "NOT FINISHED" THEN  GOTO 2560
2540  NEXT K
2545  IF E = 1 THEN 2810
2550  RETURN
2560  PRINT  MID$ (DA$(K),1, LEN (DA$(K)) - 2)
2565  PRINT "ITEM # " RIGHT$ (DA$(K),2)
2570  PRINT IT$(K)
2575  PRINT
2580  FOR Z = 1 TO 1500: NEXT Z
2590  GOTO 2540
2600  HOME : VTAB 12
2605  PRINT "WHAT IS THE DATE OF THE ITEM YOU WANT"
2610  INPUT "TO CHANGE?";DB$
2620  PRINT : PRINT "DO YOU WANT TO LOOK AT THE ITEMS FOR"
2630  PRINT "THAT DATE FIRST?";: GET A$
2633  HOME : VTAB 12
2635  IF A$ = "Y" THEN  GOSUB 2430
2640  INPUT "WHAT IS DATE AND ITEM NUMBER TO BE CHANGED?";DI$
2650  PRINT : PRINT "IS THE NEW STATUS TO BE 'FINISHED' OR"
2660  INPUT "'NOT FINISHED' ?";ST$
2665  FOR K = 1 TO N
2670  IF DI$ = DA$(K) THEN ST$(K) = ST$
2675  NEXT K
2677  HOME : VTAB 12
2680 CH = CH + 1: PRINT "OK, THE CHANGE IS MADE. DO YOU WANT TO MAKE ANOT
     HER CHANGE?";: GET A$
2685  HOME
2690  IF A$ = "Y" THEN 2605
2695  RETURN
2700  REM  ADDITIONS
2705  HOME : VTAB 12
2710  INPUT "WHAT IS THE DATE OF NEW ENTRY?";DB$
2715  HOME : VTAB 10
2717  PRINT "SINCE YOU HAVE TO GIVE AN ITEM NUMBER"
2720  PRINT "AS WELL AS THE DATE DO YOU WANT TO"
2725  PRINT "LOOK AT THE ITEMS FOR THAT DATE?";: GET A$
2727  HOME : VTAB 12
2730  IF A$ = "Y" THEN  GOSUB 2430
2735  INPUT "WHAT IS THE DATE AND ITEM NUMBER?";DA$(N + 1)
2737  HOME : VTAB 10
2740  INPUT "WHAT IS THE ITEM TO BE ENTERED?";IT$(N + 1)
2742  HOME : VTAB 10
2745  INPUT "WHAT IS THE STATUS; FINISHED OR NOT   FINISHED?";ST$(N + 1)
2750 N = N + 1:CH = CH + 1
2755  PRINT "DO YOU WANT TO ADD ANOTHER ITEM?";: GET A$
2757  HOME : VTAB 10
2760  IF A$ = "Y" THEN 2705
2765  PRINT "ARE YOU READY TO WRITE ALL THIS TO DISK?";: GET A$
2767  HOME : VTAB 10
2770  IF A$ = "Y" THEN  GOSUB 2810
2775  RETURN
2800  REM  WRITE TO DISK
2810 L = 1:D = 1:C = 1:F$ = "MEMOS"
2820  PRINT  CHR$ (4);"OPEN ";F$
2822  PRINT  CHR$ (4);"WRITE ";F$
2825  IF E = 1 THEN  PRINT NN: GOTO 2840
2830  PRINT N
2840  FOR K = 1 TO N
2845  IF E = 1 AND ST$(K) = "FINISHED" THEN 2880
2850  PRINT DA$(K): PRINT IT$(K): PRINT ST$(K)
2880  NEXT K
2890  PRINT  CHR$ (4);"CLOSE"F$:WR = WR + 1:CH = WR
2898  PRINT : PRINT : RETURN
2899  REM  SEARCH FOR DATE AND PRINT
2900 CO = 0
2905 W =  LEN (SE$)
2906  GOSUB 3000
2910  FOR K = 1 TO N
2920  IF  LEFT$ (DA$(K),W) = SE$ THEN 2960
2930  NEXT K
2940  HOME : VTAB 12: IF CO = 0 THEN  PRINT "NOTHING FOR "SE$: PRINT : PRINT
2945  PRINT " PR#0": PRINT
2950  RETURN
2960  IF CO > 0 THEN 2969
2961  HOME : HTAB 25
2962  PRINT "APPOINTMENTS FOR  ** "SE$", 1980 **"
2963  FOR I = 1 TO 80: PRINT "=";: NEXT I
2965  PRINT "THE ITEMS ON THE CALENDAR ARE:"
2967  PRINT : PRINT
2969  PRINT  MID$ (DA$(K),1, LEN (DA$(K)) - 2)
2970  PRINT "ITEM # " RIGHT$ (DA$(K),2)
2975  PRINT  TAB( 20)IT$(K)
2980  IF ST$(K) = "FINISHED" THEN  PRINT "COMPLETED"
2982  IF ST$(K) = "NOT FINISHED" THEN  PRINT "NOT COMPLETED"
2984  PRINT : PRINT
2985 CO = CO + 1
2990  FOR Z = 1 TO 3000: NEXT Z
2995  PRINT : GOTO 2930
3000  REM  PRINTER
3010  HOME : VTAB 12
3020  PRINT "PRINTER ? (Y/N) ";: GET P$
3030  HOME
3040  IF P$ = "Y" THEN  PRINT " PR#1"
3050  RETURN
22570  PRINT "ITEM # " RIGHT$ (DA$(K),2)
```


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bered d. Default values are 10 for a and b, and the beginning and end of the program for c and d.

TRACE [xx[,print list]]. Traces the logic flow of a program. After each statement is executed, its line number is printed in square brackets. The run begins at line xx if the parameter is included. The print list may be anything normally found after a PRINT command, so that variable values may be traced as the program executes. I find it helpful in some cases to include a CHR$(17) (i.e., HOME) in the print list so that the changing values stay in a fixed position at the top of the screen rather than scrolling.

HELP xx. This command is used to find a non-obvious error in a line. The line is executed in command mode until the error is found, and then the line displayed in EDIT mode with the cursor over or near the error. Note that there are some errors HELP can't detect, and also that any GOTO encountered will be executed. Still, I have found this to work, though I can envisage situations where it could be tricked by changed variable values, etc.

FIND ['] string. Lists all program lines containing the string. If it is anticipated within PRINT or REM statements, the quote should be included. A wildcard character ℒ can be used within the string to represent any single character.

DEF x. Defines a function key, where x is any single-digit number. Enter any function (series of commands to be executed) from one to 1000 characters long. Up to ten functions may be defined or redefined. Graphics RAM is used as the buffer, starting at FFFF and going down. To terminate a definition input, CTRL-C is used. To use the defined function x, just use CTRL-x. A special input character i may be used in the definition to pause for keyboard input, similar to the BASIC input statement.

VAR. Lists the values of any scalar numeric or string variables currently defined. This is helpful to find out why an error has occurred. No array variables are listed, and the list is in order of creation as the program is executed.

LIST [xx[,yy]]. Lists the program—the usual graphic shortform can be used. The listing is from line xx to yy. If the parameters are omitted, they default to program start and end, and if yy is omitted, it defaults to xx (i.e., LIST 100 lists line 100).

DEL [xx[,yy]]. Deletes lines from the program. Parameter defaults are as for LIST.

CLOSE. Eliminates all blanks other than those in REM statements or within quotes. This is used to reduce the amount of memory required to store the program.

OLD. May recover your program after a goof—accidental RESET, DEL or NEW, or a failure in CLOAD. If RESET was hit, System 3 must be restarted first by exiting to the Monitor and typing GO F070.

CTRL-P. Starts or stops output to the printer. It does not work while a program is running, but you can temporarily halt the program with the RUN/STOP key to allow CRTL-P to be used. It works in BASIC or the Monitor. The system is set up to drive the Centronics output, but it can be changed to another driver by inserting its address in locations F074 and F075.

CLOAD?. Verifies a program on tape by reading it to check for CRC errors, similar to the Monitor Files command. This ensures that there is no corruption of memory if a CRC error does occur. This command is handy if you want to be sure that the program you just saved can be reread.

MERGE. Merges a tape program onto the end of the current one. All the line numbers in the second program must be larger than the last line number in the first program. Care must be taken that no duplication or overlap of line numbers occurs. Any failure to observe this will lead to unpredictable results. The program will only be merged if the tape read is successful.

Evaluation

As you can see, quite an impressive array of commands is available with this program. System Software guarantees that it will cut programming and debugging time by half, and offers total satisfaction or your money back. Is their faith in their product justified? I think it is.

Some of the facilities offered are worth the price on their own, even without all the extra commands. Two CTRL-Ps and a LIST will get me a listing of a program. Furthermore, since unwanted control codes are filtered from the input buffer, you can input ?CHR$(12); :LIST <CTRL-P><CR> and the printer does not output the command line, since it was echoed before the printer was enabled. The purpose of the CHR$(12) or formfeed is to feed my printer to the start of the next page.

Of course, there are always more facilities you would like in any program. System Software offers a customizing service, so if you have a real need for further or modified commands, they're at your service.

System Software, 1 Kent St., Bicton, 6157, Western Australia, Australia (09-339-3842).

Dr. Ivan D. Reid
North Adelaide
South Australia

Touch Typist

Newline Software
Littleton, MA
System: Heath

I used to type about the same way I chopped firewood: with a great deal of gusto, but not much finesse.

I do a lot of writing in my job, mostly at the keyboard of my company's H-89. Thanks to our Heath AutoScribe word processor software, typing mistakes were readily corrected. Since I could muster better than 40 words per minute with my eyes (scanning the keyboard as I typed), I felt no compelling need to learn to touch type.

But I invariably had trouble transcribing material. In such cases I had the secretary do the work, rationalizing that I had something more pressing to do right then.

I think that my colleagues saw through that ruse, however, because one day a disk was anonymously left in my office with a note attached which told me to use the disk immediately. I discovered to my initial chagrin that it was a computer-aided instruction course called Touch Typist, from Newline Software. I say chagrin because I still (after all these years) have vivid memories of my high school typing class, and the horrors of learning to touch type.

My curiosity got the better of me, though, and I tried the software. While nothing can completely ameliorate the drudgery of learning to touch type, Newline Software has come up with a program to make it interesting and a challenge. The program not only helps the student learn to touch type, but also to finely hone the skills necessary to be able to type accurately and quickly. Interspersed throughout the lessons are tips on typing techniques, such as leaving two spaces after a period before the first character of the next sentence. While tips of this nature may be common knowledge to the experienced typist, they are new information for the new student. And for those who already know how to type, there are practice lessons to help improve speed and accuracy.

Each lesson begins with text which describes what new techniques will be learned in that lesson. The student is then given drill patterns to practice, followed by a review at the end of the lesson. The software uses good teaching practice by telling the student what will be taught, teaching that material, then reviewing (with speed drills usually) the material.

Touch Typist will run on any Heath H-89, H8/H19/H17 or Zenith Z89 system with 24K memory and HDOS version 1.6 or higher. The typing tutor package consists of three series of lessons:

- The T series of lessons, in which the student learns to touch type on the standard keyboard. The student is introduced to each letter on the keyboard, one letter at a time. After completion of this series of lessons, the student is able to touch type the entire alphabet and some of the standard symbols by touch.
- The N series of lessons teaches touch

typing on the numeric keypad (the numeric keys on the right side of the keyboard). This feature is particularly useful for data entry applications (and using a push-button telephone).

● The S series reinforces the T series with speed and accuracy drills. This series of lessons consists primarily of paragraphs for the student to type. There are also valuable hints and rules of style.

Each lesson contains practice drills to improve speed and accuracy. Touch Typist displays a line of text in the middle of the screen, and instructions, if appropriate, at the top of the screen. The student then types the line as shown. The program checks each character as it is entered. If the character is correct, nothing happens. If the character is incorrect, then a large X is displayed under the erroneous character and the terminal bell beeps (you soon learn to hate that bell).

If an error is made, nothing can be done about it during that drill because the backspace key is not operative (indeed, the backspace key isn't even taught until about halfway through the T lessons). The student finishes that drill, after which the same drill is presented again. The program checks each drill for the number of errors made. If the number of errors on any given drill is not excessive (it seems to vary from drill to drill), then

> My typing speed went from 40 wpm with my eyes keeping my fingers honest to 40 wpm without looking.

the next drill is presented. If the number of errors is excessive, the same drill is continuously presented to the student. If, after a few futile attempts, the student has not mastered the drill, the program offers a graceful way out of the drill: simply hit the escape key to move on to the next lesson.

The program is not totally forgiving, however. If the student takes the easy way out of a particularly difficult drill, the tally at the end of the lesson tells the student that the lesson was completed but a number of lessons were skipped (it tells how many).

Most lessons end with a speed test. This is where a personal computer really comes into its own for tutorial lessons. The challenge is there to better one's previous typing speed and accuracy, and the speed drill is there whenever the student wants to try it, whether it is immediately after completing a previous lesson or three o'clock in the morning.

Touch Typist will display a paragraph on the screen. The student should then type the entire paragraph as quickly and as accurately as possible. As each character is entered, it is checked for accuracy. If it is correct, again nothing happens. If it is incorrect, Touch Typist will beep the terminal bell again and write the errant character in reverse video (a black character on a white background). Now, however, the backspace key is operational. The student may correct any typing errors by using the backspace key, but the character will still be counted as an error. To add further challenge, a timer is started as soon as the first key is struck and does not stop until the paragraph is completed.

For those with a low frustration threshold, it is possible to "fool" the computer into thinking that the paragraph has been finished by holding down any key, along with the repeat key, until the end of the paragraph is reached. At that time simply hit the carriage return and watch your blistering speed of 224 wpm (words per minute) flash on the screen. Of course, the number of errors is also displayed, which in that case will be considerable.

The important thing to note is that at the end of each speed drill, the number of errors and the typing speed in words per

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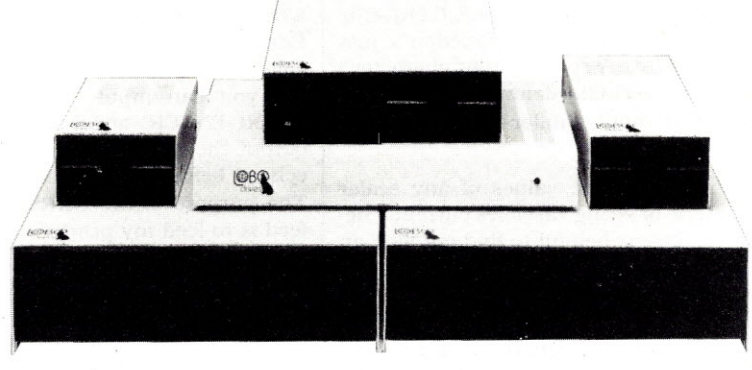

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minute (wpm) is displayed, thereby giving the student immediate feedback.

The nonbootable, write-protected disk comes with two sheets of instructions, for either single-drive or multidrive systems. An owner with absolutely no experience with using system programs such as Onecopy should have no trouble whatsoever following the instructions. I wish that all software houses would pay as much attention to documentation as Newline Software has.

But does it work? Absolutely. The user's success will certainly depend upon how well the lessons are followed, and how well the user applies him- or herself. No computer-aided instruction program can assure that the student will have perfect mastery of the material at the end of the lessons. But the student's success is in part a measure of the program. In my case, my typing speed went from 40 wpm with my eyes keeping my fingers honest to 40 wpm without looking. I now have not only the ability to transcribe material without resorting to my old typing method, but I also have the skills necessary to improve my typing speed and *accuracy*. After all, the name of the game is accuracy.

Newline Software, PO Box 402, Littleton, MA 01460.

J.C. Hassall
Blacksburg, VA

CRAE

Highlands Computer Services
Renton, WA
System: Apple II
$15

Writers of BASIC programs have many tedious housekeeping chores. They have to number the lines of their programs. They have to keep these line numbers consistent during such procedures as GOTO and GOSUB, particularly as the programs are being revised. They have to keep the spelling of variable names consistent; and if they need to change the spelling of a variable name, they must change every occurrence of that variable.

BASIC program writers also sometimes have to patch one program into another; or repeat virtually the same sequence of commands in different parts of the same program; or, in debugging, locate every occurrence of a given string.

These are boring tasks. Programmers like to have utility programs which do these chores. One such program, designed for the 48K Apple II, is CRAE (Co-Resident-Apple-Editor) sold by Highlands Computer Services, Renton, WA.

At $15, CRAE is a good buy, a useful tool for those users who are more than casual programmers. It will join two BASIC programs together; it will find and change strings within a program; it will list a program or provide a hexadecimal dump of a range of memory; it will "quote" one section of a program in another section; it will automatically number and renumber program lines. And it does all this with just nine short commands.

The Program

You first boot the system with the CRAE disk, or use the PR#6 command. CRAE is then automatically loaded in the 12K of memory below 48K, and you are asked, "Do you want instructions?" If you say, "No," the machine returns to Applesoft II BASIC, and CRAE becomes "invisible."

When you need CRAE, you must first type an ampersand (&) as the first character in a line on the CRT. CRAE will then drop down to the next line and display a left bracket (ASCII character 219 decimal, DB hex). This contrasts with the Applesoft right bracket prompt (ASCII 221 decimal, DD hex).

One serious flaw at this point: apparently the only practical way for users to return to Applesoft (and, for example, run their programs) is to hit the reset key. This isn't fatal though; you're returned to BASIC rather than to the machine monitor, and both CRAE and the user program are intact. Still, it does seem reasonable to ask that CRAE have a graceful exit procedure, and/or a facility for running BASIC programs within CRAE's umbrella.

The commands are simple. Each begins with a single letter; then, depending on the command, you can have from zero to four parameters which specify the string to be located or changed, or the range of lines to act upon. Each parameter (except, in some cases, the first) is separated from the others by either a slash or a comma. The commands would be even simpler, of course, if the delimiter were consistently either a slash or a comma, and if the delimiter were consistently required (or not required) for the first parameter as well as the others; but these inconsistencies are a nuisance, not a serious flaw.

The Append command joins two BASIC programs together. The first program is brought into memory; the Append command is issued, and you're prompted for the name of the second program, which should be on disk. Be sure the line numbers of the second program are larger than those of the first.

The Change and Verify commands both alter a given string. Both can be limited to a specific line range. The difference is that Verify, in spite of its name, does not verify—i.e., echo—the change. The Find command will locate a given string, but will not change it. Like the Change and Verify commands, it can be set to operate within a specified line range.

The Quote command repeats a given range of lines in a different section of the program without deleting the original set of lines. The same sequence of commands can therefore be used in two different parts of the program; and there are some situations where this procedure is preferable to the use of the GOSUB command—where, for example, the programmer wants to avoid jumping out of or into a FOR . . . NEXT loop.

The Auto Line Number command (which uses the letter N) automatically provides line numbers for a program. You can specify the starting line number and the increment. The Dump command gives a hexadecimal dump for a specified range of memory, a function duplicated in the Applesoft ROM.

The Renumber command is also duplicated in Applesoft; in fact, the Applesoft version is somewhat better because it can handle longer programs. And finally, the List command essentially duplicates the Applesoft List command, but does not produce as readable a listing because it eliminates "extraneous" spaces.

As far as I can tell, the error-trapping routines are flawless—although the error messages are sometimes cryptic ("err<0," for example). Still, experienced programmers should have few problems deciphering the error messages; often they simply mean that the user has entered a BASIC command or line number instead of a CRAE command.

The Most Serious Problem

The most serious problem with CRAE, as with so many programs, is the user documentation. The user's manual has 17 double-spaced pages, including the cover, and not all of these are full pages. Most of the commands are explained in less than one page. This one page will explain the purpose of the command and present the format for the command. In many cases it will also present a few examples of the command format. But there are very few examples of the results (i.e., printouts showing what happens when you use the commands.)

Also, no tutorial is included to lead users step-by-step through the program. Tutorials are probably the most effective device available for showing users how a program works, and I believe that every user's manual should contain one. In CRAE's case, it would have been easy to include a tutorial on the disk.

If we assume that CRAE is intended only for experienced programmers, we can to some extent excuse its poor documentation (although I have to wonder why people who hope to make money from their programs would exclude less experienced programmers from their market). CRAE is simple enough that experienced programmers can figure out for themselves just how the commands operate. Still, while I get satisfaction from solving the puzzle of what the commands do, it is only grim satisfaction, tempered by resentment that the authors have presented me with this unnecessary puzzle.

But in spite of its poor documentation

and its lack of a graceful exit routine, I am satisfied with CRAE. It probably does no more than many other programmer aides (such as Applesoft's DOS Toolkit), and perhaps it does not do them as well. But I am content. I was weary of eyeball editing, and I'm delighted with the help that CRAE gives me. Especially when I look at that $15 price tag. You'll have a hard time beating that.

Highland Computer Services, Renton, WA.

Brownlee Elliott
Bloomfield Hills, MI

Flash Attack

Mach 2 Software
Danbury, CT
System: PET
$15

Flash Attack is a multimachine game that provides infinitely more challenge than do the you-against-the-computer games.

The 40 × 60 playing field shows a terrain of mountains, consisting of cross hatched squares, or forest, represented by groups of trees. Both players have a command post, five tanks (to be used one at a time), walls to build dummy command posts, land mines, missiles and tank and command post guns. The object is to destroy your opponent's command post (actually a wall of the command post).

The game is challenging because you can't see the entire playing field, only a small window around your command post and the current position of your tank. The numeric keypad moves your tank, using one unit of fuel for each square moved. In the heat of battle, it's easy to forget this and end up stuck far away from your base.

Tanks may not move over the mountains, nor can shells destroy mountains. Tanks may pass through forests, and any kind of a shell will destroy them. Mines laid by your tank are visible to you, but not your opponent. A square containing a tree cannot contain a mine.

CB2 sound effects indicate firing a gun, hitting a mine and launching an ICBM.

If your tank is hit by a shell from another tank, it will go from condition green to amber, or from amber to red, or from red to destroyed. Running over a mine is equivalent to being hit by two tank shells. If a tank is hit by either a command post gun or an ICBM, it will be destroyed no matter what its condition was. A tank in condition red will move only about half the time a direction key is pressed. Returning to the command post will completely repair and reequip the tank.

As good as this program is, it has a few drawbacks. The most obvious is that it is much easier to come up with two people to play the game than two PETs to play it on. Also, the program is uncopyable; I worry a little about what happens when my tape wears out. Hopefully, it will soon be available on disk.

Occasionally random patterns of mountains box in a command post, making that game unplayable. Both tanks are represented as diamonds. It would be easier if they could be distinguished from one another. Occasional keystrokes cause the program to jump back to BASIC for no apparent reason.

My user group has spent the better part of its last three meetings playing Flash Attack, making it the most popular game we've ever tried. The authors have indicated they are working on other games of this type. We hope so, because we'd like to encourage them to continue to produce what would be best described as a new class of games.

Mach 2 Software, 96 Hammersmith Apts., Danbury, CT 06810.

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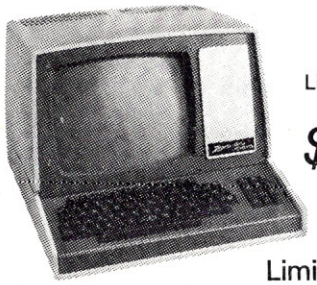

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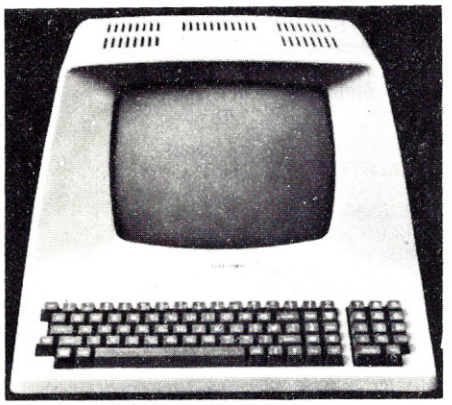

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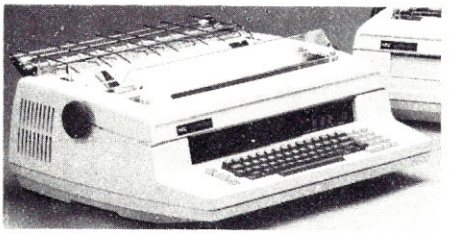

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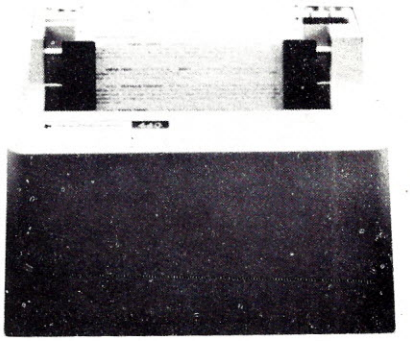

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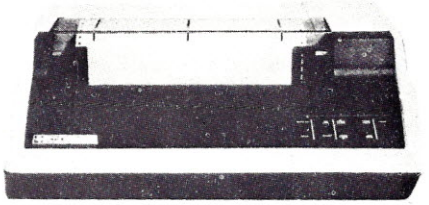

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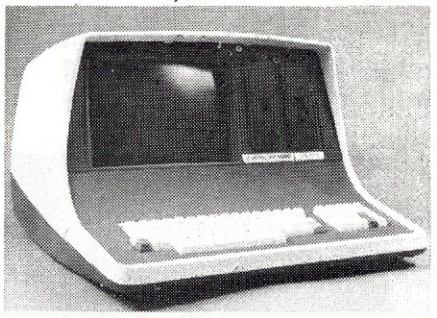

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System 3

System Software
Bicton, Western Australia
System: Exidy Sorcerer
$29.95, $2 extra for air mail

Exidy's Sorcerer is a fine machine, with one of the quickest BASICs around. However, this speed is achieved at the expense of some complexity and numerical accuracy. For most applications, the accuracy is unimportant, but there are times when you wish that the ROMPAC supported a few more features (see, for example, "A Sure Cure for Those '?SN ERROR' Blues" by Randy L. Henne, May 1981, p. 142). Now there is a simple and relatively inexpensive method to add editing, renumbering, and several other facilities to your Sorcerer.

Richard Swannell, a young Perth programmer, has set up a small software house in Western Australia dealing exclusively in Sorcerer software. One of his offerings is a programmer's aid which can cure most of the blues a Sorcerer programmer may have. For your $29.95 (plus $2.00 for airmail—recommended because of the slow surface mail to and from Australia) Richard will send you a cassette containing the program, and a small printed sheet explaining the facilities that are offered.

The tape is recorded with three copies of the program, two on the first side at 1200 baud and one on the reverse at 300 baud. The tape is protected against unauthorized copying, but Richard offered to let me know how to defeat that if it turned out to be a problem. I believe future copies will not be protected. I have had no problems loading the tape at the higher speed, though I always record my own programs at 300 baud for extra security.

The program must be loaded before you start entering your BASIC program, as it first loads into low memory normally occupied by BASIC source code. It is recommended that the LOG command be used. But I've successfully operated it by using the GO command after a normal load. When loading, the Monitor message is indicating a program 1050 bytes long starting at 0F00 and an auto-execution address of 0F00 as well. Once loaded and execution has commenced, the program relocates itself into the top of RAM and resets the BASIC top-of-RAM indicator to prevent it from being overwritten. In this way, the program can be used with any memory size, operating just as well on my 48K machine as it would on an 8K Sorcerer.

After the program signs on, the aid is transparent to the user until he wants to use some of its facilities. It works by intercepting input and output to check if any action has to be taken by System 3, allowing all other I/O to pass through to the ROMPAC or Monitor programs.

Keypad right-arrow	Move cursor right
Keypad left-arrow	Move cursor left
Keypad X	Scan cursor
Keypad '=' or CLEAR	Delete character under cursor
Keypad '.'	Truncate line
Keypad divide	Toggle mode (X or R)
RUB	Backspace (RUB in command mode).
TAB	Now tabs
REPEAT	Repeats last key
CTRL-C	Quit without editing
RETURN	Enter edited line
Keypad down-arrow	Enter current line and edit next
Keypad up-arrow	Enter current line and edit previous

Table 1.

Facilities

In the following descriptions, an item enclosed in square brackets [] is optional.

EDIT xx[,yy]. Edit line xx. The graphic shortform for EDIT is GRAPHIC-E. The keypad is used to control the editor, and no shift is required to activate the cursor-control keys. A special buffer is used to ensure that longer lines can be entered without problems. The line being edited is displayed on the screen between two delimiting characters with an inverse cursor over the first statement.

The commands are shown in Table 1.

The two modes, replace (R) and expand (X), are indicated by a single character at the top of the screen. In R mode, typing a character will replace the character under the cursor with the one typed, and move the cursor to the next position. In X mode the cursor and the rest of the line shift along and the typed character is inserted before the cursor. In R mode, typing up to the end-of-line delimiter will expand the delimiter across the screen and onto the next line if necessary.

If the down-arrow command is given when the current line is the last line in the program, a new line number is displayed with value yy greater than the last.

AUTO [xx[,yy]]. Enters AUTO mode. The next line number is displayed on the screen ready for a new line. If the line number is duplicated in the program, a full colon is displayed under the cursor. If a new line is not to be entered, LINEFEED skips to the next line.

All edit commands are available, but once you have gone into EDIT mode (e.g., used cursor-up to edit a mistake in a previous line) then RETURN will put you back to command mode. Parameter xx is the initial line number, and yy is the increment.

REN [a[,b[,c[,d]]]]. Renumber BASIC program with first new line number a, increment b, first line of original program to be renumbered c, and last to be renum-

(continued on page 203)

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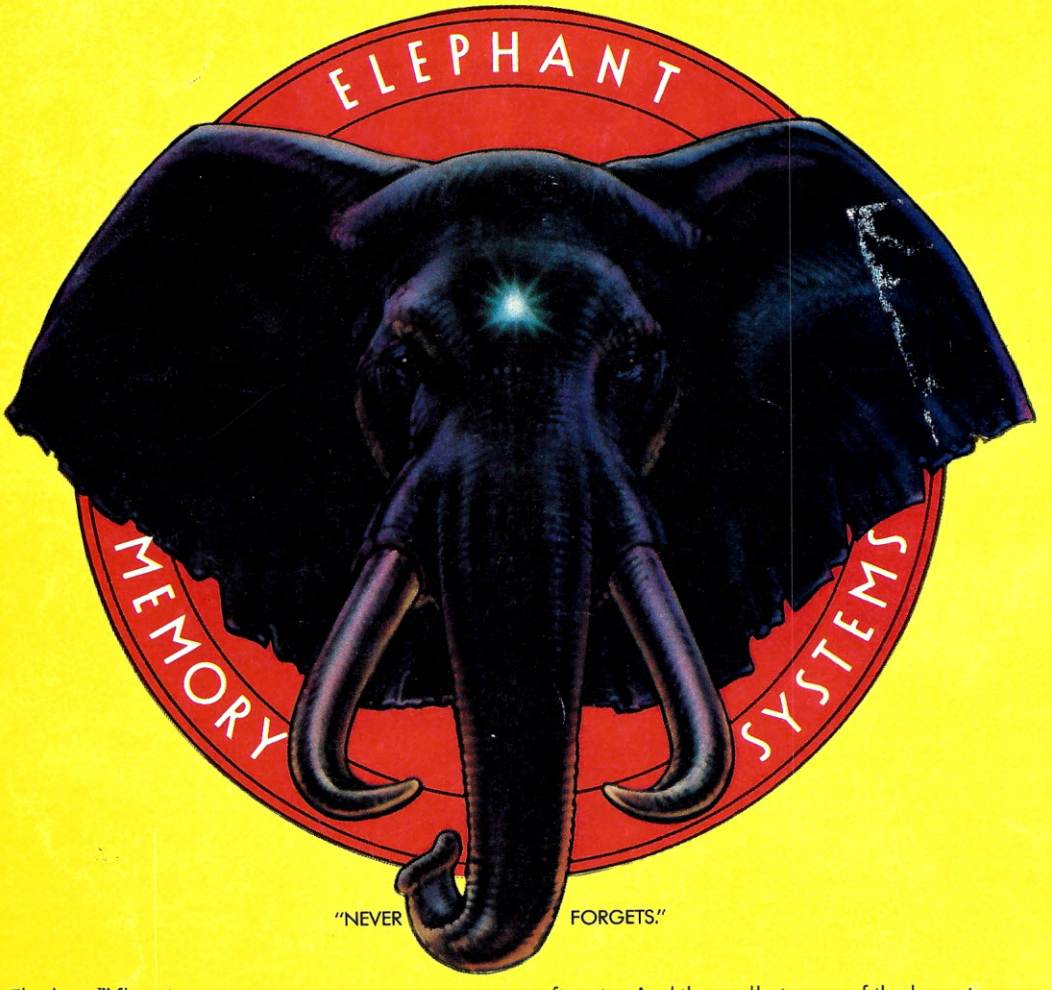

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